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Paleontological Inventory and Assessment  
of the Southeastern Portion of the Royal Gorge  
Resource Area, Central Colorado  
Bureau of Land Management

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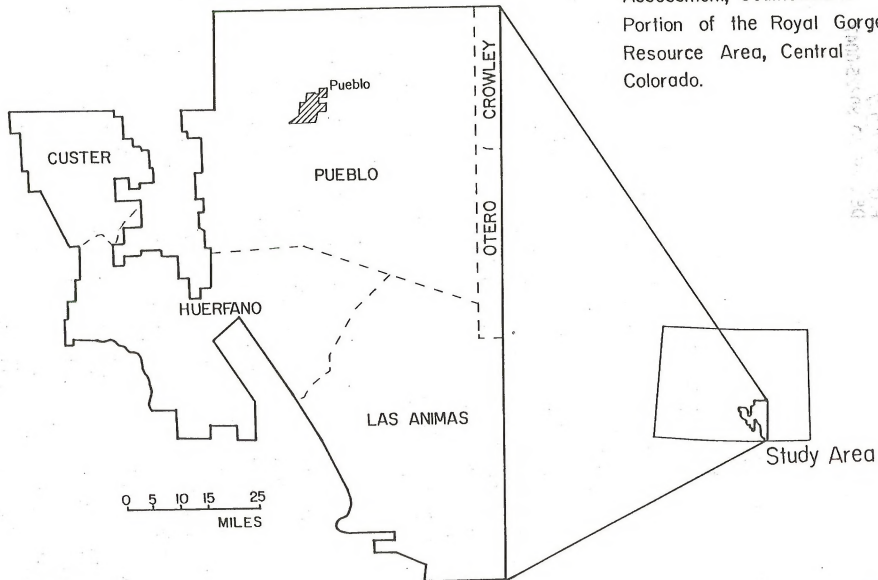
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Paleontological Inventory and  
Assessment, Southeastern  
Portion of the Royal Gorge  
Resource Area, Central  
Colorado.





## Introduction

This study is the result of Bureau of Land Management contract No. 4112-1173 CO-050-PP2-15, providing for a paleontological inventory and assessment of the southeastern portion of the Canon City Resource Area (see Map of the Study Area). Work was begun on May 6, 1982 and was completed on February 15, 1983. The results of the study are to be used primarily for planning purposes. It is hoped that the information contained within this report will be of use in the recognition, assessment, and mitigation, if necessary, of land use conflicts arising where fossil remains of significant scientific value may be impacted.

Specification for this inventory and assessment call for the classification of all Federal surface and mineral lands within the southeastern Canon City Resource Area into three categories which recognize the scientific value and importance of fossil remains. The classification is as follows:

Class 1-a: Immediate detailed study follow-up is needed. Fossils of scientific interest are exposed on the surface, or are very likely to be discovered with detailed field work in the area. This classification is to be used for site-specific localities having scientifically significant fossils.

Class 1-b: Other areas having a high potential for scientifically significant fossils (Morrison Formation, etc.). In these areas, a paleontological evaluation will be done by the geologist, on a case-by-case basis, prior to any surface-disturbing activities. These

evaluations will change this classification to Class 1-a, Class 2, or Class 3, as appropriate.

Class 2: There is evidence of fossilization, but the presence of fossils of scientific value has not been established, and is not anticipated. Detailed study may be desirable in the future for the evaluation of all types of fossil collecting. This classification may be used in identifying recreational values in fossils.

Class 3: Little likelihood of finding fossils of use. No further considerations of fossils necessary unless future discoveries require a change of classification.

Most of the formations in the study area have produced fossils either within the area or elsewhere in the region and vicinity. Emphasis was placed on existing localities and on the likelihood and importance of additional fossil material being discovered in a given formation in the study area. The criteria upon which the classifications were made are rarity of occurrence, amount of study a species or group has undergone, and scientific significance. A high percentage of the fossil-bearing formations are designated as Class 2 and these are shown on the key maps as green. Those areas designated as 1-b are shown in red, and Class 3 designations are shown in brown. There are no 1-a designations. Due to restricted map resolution on small tracts of Bureau of Land Management (BLM) land, when a Class 1 and Class 2 formation are present the entire area is colored Class 1. When Class 2 and Class 2 formations are present in a small area, and if no fossils

are known and field observation provided insufficient data, the color is based on the formation with the greatest percentage of area.

Field work was conducted for the purpose of locating existing sites, to determine the extent of exposure of a given formation, and to determine the proximity of Federal mineral lands to formation outcrops. Fossil remains in the study area represent a variety of biotic groups including marine and terrestrial vertebrates and invertebrates, plants, and some trace fossils. In general, the study area is varied lithologically and in the flora and fauna recovered.

References to genera and species listed in the text have been reported as they appeared in the literature. No attempt has been made to revise the taxonomy. The bibliography includes references that were not cited in the text nor specifically pertinent to the study area. These references do, however, suggest what resources may be found in the study area but have not yet been reported.

We would like to acknowledge the assistance of the following people: Kevin Anderson and Roger Underwood of the BLM Office in Canon City, and Kenneth Carpenter, Mary Maas, and Peter Robinson of the University of Colorado Museum in Boulder. While we are grateful for the assistance of these people, we remain entirely responsible for the information and recommendations presented in this report.

## Geology

The Southeastern Portion of the Royal Gorge Resource Area includes the southern part of the Wet Mountain Valley, Huerfano Park, and a portion of the southern Great Plains. The Wet Mountain Valley is bounded on the west by the Sangre de Cristo Mountains and on the east by the Wet Mountains.

The Wet Mountains are the eastern-most range of the Rocky Mountains. They are located south of Canon City and trend in a northwest-southeast direction. The mountains are formed of Precambrian granite. The eastern flank is similar to that of the front range except that it contains more faults in the sedimentary layers. At their southern-most extent the mountains plunge into the plains. The western slope of the Wet Mountains is covered by debris from the mountains and Cenozoic lava flows.

The Sangre de Cristo Mountains extend 150 miles from Salida to New Mexico. The central portion of the eastern slope is composed predominantly of late Paleozoic rocks. These are folded and faulted but are not metamorphosed. The rocks are mostly continental but some marine sediments are also present (Tischler, 1963). Sandstones, shales, and conglomerates are present, and some layers are fossiliferous. The northern end of the Sangre de Cristos consists of Precambrian igneous and metamorphosed rocks. South of La Veta, past the Spanish Peaks, are the peaks of the Culebra Range. The Spanish Peaks themselves are the center of a large system of radiating dikes. These igneous intrusives were part of Cenozoic volcanic activity, and the dikes are very thick in the Minturn area.

Huerfano Basin consists of sediments which were deposited rapidly from the Upper Cretaceous through the Oligocene. However, late Cretaceous and earliest Tertiary sediments are missing, and deposition was discontinuous from the late Eocene into the Oligocene. The marine sediments of the Great Plains were primarily deposited by the Cretaceous Sea, followed by latest Tertiary terrestrial deposits.

List of Formations

Quaternary	Alluvium
Tertiary	Devil's Hole Formation Farisita Formation Huerfano Formation Cuchara Formation Poison Canyon Foramtion
Upper Cretaceous	Raton Formation Vermejo Formation Trinidad Formation Pierre Shale Niobrara Formation Carlile Shale Greenhorn Limestone Graneros Shale
Lower Cretaceous	Dakota Sandstone Purgatoire Formation
Jurassic	Morrison Formation Ralston Creek Formation Entrada Sandstone
Pennsylvanian-Permian	Minturn Formation Kerber Formation Sharpsdale Formation Fountain Formation Sangre de Cristo Formation
Permian-Triassic	Lykins Formation
Devonian-Mississippian	Williams Canyon Limestone Hardscrabble Limestone Beulah Limestone
Ordovician	Fremont Limestone Harding Sandstone

## Ordovician

### Harding Sandstone (Middle Ordovician)

The Harding Sandstone consists of a basal thin-bedded conglomerate a middle shale, and an upper thin-bedded to massive sandstone with red siltstone or shaly siltstone (Sweet, 1961). It rests on Precambrian rocks in the study area, and reaches a maximum depth of 186 feet. The only outcrop of Harding Sandstone in the area is near Beulah.

There are two localities in the study area (see Appendix I). They have produced mainly conodonts and invertebrates (Sweet, 1954 and 1955). In general, however, the Harding megafauna is dominated by molluscs. The sediments also contain possible sponges, trilobites, and brachiopods all of which are not very well preserved. The conodonts are well preserved, varied, and are useful in correlation. The only vertebrates found are the primitive fish Astaspis, Eriptychius, and Dictyorhabis (Johnson, 1934; Sweet, 1961 - see Table 1). Based on the common invertebrate fauna, its poor preservation, and on the usefulness of the conodonts in correlation, this formation is designated as Class 2.

### Fremont Limestone (Middle and Upper Ordovician)

The Fremont Limestone is a pink to tan buff, crystalline granular dolomite which weathers to pits and cusps. The formation outcrops near Beulah where it is 10 to 20 feet in depth. It thins to the south.

There is one known locality in the study area (Appendix I). Information as to what species have been produced by this site is

Table 1: Species of the Harding Formation.

## Porifera?

Cictyvorhabdus priscus

## Brachiopoda

Lingula attenuataLingula huronensisLingula (Glossina) hurlbuti

## Gastropoda

Ecculiomphalus contiguusLiospira sp.

## Pelecypoda

Ctenodonta spp.Cyrtodonta sp.Modiolopsis sp.Othodesma sp.Vanuxemia rotundata

## Cephalopoda

Kionoceras sp.Ormoceras pollackiOrmoceras? sp.

## Nautiloidea

Orthoceras multicameratumUtoceras cf. U. gleneyriense

## Trilobita

Isalaux canonensisTornquistia sp.

## Vertebrata

Astraspis desiderataEriptychius americanus

## Conodonta

Amorphognathus lingualisA. ramosaChirognathus admirandaC. AequidentataC. alternataC. cultidactylaC. deformisC. delicatulaC. dubia



Table 1 continued.

C. duodactyla  
C. eucharis  
C. gradata  
C. idonea  
C. maniformis  
C. monodactyla  
C. multidentis  
C. parallela  
C. plana  
C. tenuidentata  
C. unguliformis  
C. vulgaris  
C. spp. undet.  
Coleodus delicatus  
C. simplex  
Cordylodus concinnus  
C. plattinensis  
C. sp.  
Curtognathus calyculoides  
C. limitaris  
Cyrtionodus complicatus  
Dichognathus brevis  
Erismodus abbreviatus  
E. radicans  
E. simplex  
E. typus  
Lonchodus spinuliferus  
Microcoelodus asymmetricus  
M. expansus  
M. magnicornis  
M. simplex  
M. unicornis?  
Mixoconus primus  
Neocoleodus brevicornis  
Oistodus curvatus  
Ozarkodina concinna  
O. pauperata  
O? sp.  
Paltodus sp.  
Phragmodus primus  
Polycaulodus bidentatus  
P. cornulatus  
P. peculiaris  
P. reversus  
P. tridentatus  
Prionognathus ordovicicia

Table 1 continued.

Ptiloconus compressus  
P. gracilis  
P. tortus  
Scolopodus brevis  
Scyphiodus sp.  
Steroconus gracilis  
S. plenus  
S. robustus  
Subcordylodus rectileatus  
S. sinuatus  
Trichonodella deformis  
T. pumila  
T. recurva

not available. The Fremont Formation in Colorado, however, has produced brachiopods, sponges, eichinoderms, gastropods, cephalopods, trilobites, and corals (Brainerd, Baldwin, and Keyte, 1933; Johnson, 1934; Sweet, 1955 and 1961 - Table 2). The formation is designated as Class 2.

Table 2: Species from the Fremont Formation.

## Cephalopoda

Actinoceras sp.  
Beloitoceras accutum  
E. sp.  
Cyclendoceras cylindricum  
Cyrtoceras sp.  
Endoceras SP.  
Ephippiorthoceras formosum  
E. sp.  
Gomphoceras sp.  
Kionoceras sp.  
Lambaeoceras sp.  
Lituities sp.  
Neumatoceras sp.  
Ormoceras sp.  
Orthoceras formosum  
Probelliingsties bessleri  
Spyroceras sp.

## Corals

Calapoecia sp.  
Halysites catenulatus  
H. gracilis  
H. sp.  
Paleofavosites sp.  
Paleophyllum thomi  
Saffordophyllum franklini  
Streptelasma cf. S. rusticum  
S. sp.  
Zaphrentis sp.

## Nattiloidea

Allumettoceras sp.  
Charactoceras canyonense  
Cyrtogomophoceras contractum  
Diestoceras occidentale  
D. walcotti  
Fayettoceras? canyonense  
Fremontoceras loperi  
Nanno walcotti  
Neumatoceras? sp.  
Richardsonoceras? subcuneatum

Table 2 continued.

## Brachiopoda

Hebertella sinuataLepidocyclus capaxL. sp.Falesiomys bellilamellosusPlaesiomys proavitaRhychotrem (Lepidocyclus?) argenturubicumR. capaxSinorthis subquadrataStrophomena spp.Zygospira modesta?

## Gastropoda

Bucanella sp.Helicotoma sp.Lophospira perforataTrochonema umbilicatum

## Porifera

Receptaculites cf. R. arcticusR. owenii

## Pelecypoda

Modiolopsis sp.

## Trilobita

Ceraurinus icarus

## Devonian-Mississippian

### Beulah Limestone (Mississippian)

The Beulah Limestone is a predominantly pink to red stained or white to buff finely oolitic limestone. It contains concentrations of reddish-yellow dense chert and pyrite in its upper-most layers. It also contains traces of red sandy chert. The Beulah Limestone overlies the Hardscrabble Limestone. The type section outcrops as the upper ledge in cliffs north and west of Beulah (Appendix I), and reaches a thickness of 53 feet. The cross-stratified, sandy, crinoidal, oolitic, lime grainstones, and quartz and feldspar sand grains suggest a nearshore, high-energy deposit.

The fossils from the Beulah Limestone are limited. They include several invertebrate species such as the brachiopod Koninckopora minuta, Eoendothyranopsis pressa and Calcisphaera laevis, forams, and the algae Aocygalia (Ramirez, 1974). The Beulah is designated Class 2 as more study is needed in this formation.

### Hardscrabble Limestone (Middle Mississippian)

The Hardscrabble Limestone is a light buff to dark brown finely crystalline to dense limestone. Lower layers contain pink-gray-white dolomite and dolomite limestone. Tan to brown chert is present locally. Upper layers are a dense red-orange chert with medium-sized oolites. At Beulah and Hardscrabble Creek the base is marked by a thin bed of conglomeratic limestone, 40 to 124 feet thick. The type locality is exposed in Custer County (S½ Sec. 11, T.22S., R.69W.). The Hardscrabble rests unconformably on the Williams Canyon Limestone.

Fossils present in the Hardscrabble are limited and include crinoids, brachiopods, ostracodes, foraminifera, and calcispheres (Ramirez, 1974). Spirifers are also present and common. The formation is designated Class 2 as it needs more study.

Williams Canyon Limestone (Upper Devonian to Lower Mississippian)

The Williams Canyon Limestone is a pink to red stained, white to buff fine oolitic limestone. Upper layers contain red to yellowish dense chert and pyrite with traces of red sandy chert. It forms a continuous upper ledge in cliffs north and west of Beulah. The formation is approximately 53 feet thick.

Fossils have been reported from the Williams Canyon but they are limited to scarce. Ramirez (1974) suggested that this scarcity or lack of fossils is one of the characteristics of a supratidal environment. As with the other formations of this group, the Williams Canyon is designated Class 2 as it requires more study.

## Permian-Triassic

### Lykins Formation (Permian and Triassic)

The Lykins Formation is a red, thin-bedded siltstone and sandy shale with some dolomite, limestone, and gypsum. It reaches a maximum thickness of about 180 feet near Colorado Springs. The Lykins is restricted in its outcrop and the only exposures in the study area occur in Fort Carson.

Fossils are rare. A fish has been reported from near Canon City and the lower Lykins contains Permian invertebrates, particularly brachiopods. The formation is designated as Class 2.



## Pennsylvanian-Permian

### Sangre de Cristo Formation (Pennsylvanian-Permian)

The Sangre de Cristo Formation is a thick sequence of red arkosic sandstones and conglomerates interbedded with siltstone, shales, and thin limestones. Within the study area, conglomerates contain fragments from  $2\frac{1}{2}$  to 3 inches in diameter. Further north, the conglomerate material increases in diameter. The Sangre de Cristo unconformably overlies the Minturn Formation, and it reaches a thickness of 9,000 feet.

No fossils are known from the study area. Out of the study area, however, the Sangre de Cristo produces brachiopods, fish, amphibians, reptiles, and some floral specimens (Vaughn, 1972; White, 1912 - Table 3). This formation is designated as Class 2. It is important as it provides us with the first knowledge of late Pennsylvanian North American tetrapods west of eastern Kansas (Vaughn, 1972).

### Fountain Formation - Pennsylvanian-Permian)

The only outcrop of the Fountain Formation in the study area is near Beulah. It overlies the Beulah Limestone and is generally a thin to thick irregularly bedded coarse-grained arkose and conglomerate. Red and maroon are the predominant colors of the sediments. There are local thin beds of shale, limestone, and dolomite. The sediments are considered to be coalescing alluvial fans from the ancestral Rocky Mountains.

Fossil remains are not plentiful nor varied. They include brachiopods, bryozoans, crinoids, plants, ostracodes, and

TABLE 3: Species for the Sangre de Cristo Formation.

## Brachiopoda

Dictyoclostus sp.

## Elasmobranch fish

## Amphibia

Coloraderpeton brilli, n. gen and sp.

Large embolomere

Several small rachitomes

## Reptilia

Desmatodon hesperisEdaphosaurus aff. E. raymondiE. cf. E. raymondiTrichecaton howardinusOphiacodont

## Flora

Callipteris sp.Macrostachya?Odontopteris subcrinulataPsymphyllum cf. P. cureifoliumRhabdocarpes dyaicusSigillariostrobus mastatusWalchi cf. W. imbricataW. cf. W. piriformis

conodonts (Brill, 1952; Finlay, 1907; McLaughlin, 1947 and 1952 - Table 4). Although none of these fossils have been found in the study area, the area is designated Class 2 as more study is needed.

#### Sharpsdale Formation (Pennsylvanian)

The Sharpsdale Formation was described by Bolyard (1956) as the Deer Creek Formation. Chronic (1958) stated that that name was preoccupied and substituted the term Sharpsdale. DeVoto et al. (1971) also use the name Sharpsdale. The formation is a dark red arkosic sandstone, siltstone, and shale with gray limestones in the upper zone. It gradationally overlies the Kerber Formation in the study area, and reaches a thickness of 900 feet. The sediments were deposited in an arid climate as alluvial fans and plains with occasional marine transgressions.

Fossils from the Sharpsdale localities (see Appendix I) in the study area include foraminifera, brachiopods, gastropods, corals and ostracodes (Bolyard, 1959; Brill, 1952; DeVoto et al., 1971; Gwinn, 1958 - Table 5). The area is designated a Class 2.

#### Kerber Formation (Pennsylvanian)

The Kerber Formation consists of light gray to grayish-yellow quartz sandstones and conglomerates in the study area. In other areas it is composed of dark, carbonaceous or coaly shale and sandstones. It rests unconformably on Precambrian crystalline rocks and reaches a thickness of 104 feet. The upper contact with the overlying Madera Formation is obscured by soil along

Table 4: Species of the Fountain Formation.

## Ostracodes

Amphissites congruens  
A. robustus  
A. wapanuckensis  
Bairdia hoxbarensis  
B. oklahomaensis  
Cavellina cf. C. fittsi  
Geisina arcuata  
Glyptopleura aff. G. coryelli  
Healdia formosa  
Hollinella kelleetae  
Kirkbya clarocarinata  
Microparaparchites brazoensis  
M. cornutus  
Monoceratina ardmorensis  
Polytylites wapanuckensis  
Pseudoparaparchites sp.

## Conodonts

Cavusgnathus flexa  
C. giganta  
Idiognathodus aff. I. claviformis  
I. delicatus  
I. lobatus  
I. magnificus  
Polygnathodella ouachitensis  
Spathodus minutus  
Streptognathodus cancellosus  
S. sp., undes.

## Brachiopoda

Chonetes sp.  
Dalmanella testudinaria  
Dityoclostus sp.  
Orbiculoidea manhattanensis

## Flora

Lepidodendron aculeatum  
L. obovatum

## Misc.

Fragments of bryozoans, corals and echinoderms

Table 5: Species of the Sharpsdale Formation.

## Brachiopoda

Cleiothyridina orbicularis  
Composita subtilita  
Dictyoclostus protlockianus  
Lissochonetes geinitzianus  
Marginifera muricata  
M. cf. M. muricata  
Neospirifer cameratus  
N. cf. N. latus  
Orbiculoidea capuliformis  
Spirifer cf. S. occidentalis  
S. cf. S. opimus  
S. rockymontanus

## Gastropoda

Bellerophon sp.  
Meekospira peracuata var. choctawensis

## Coelenterata

Caninia sp.  
Syringopora multattenuata

## Foraminifera

Fusulinella devexa

## Ostracodes

the entire extension of the Kerber Formation (Okumura, 1979). The abundant plant material, coal beds, and channel sandstones all suggest deposition in non-marine coastal plains, swamps, and mudflats.

Bolyard (1956) reported no diagnostic fossils from the Kerber. Okumura found no fossils in the sandstone but did find fragmentary brachiopods (Neospirifer sp. and Composita sp.) in the conglomerate. The specimens were fragmentary and difficult to separate from the rock. The formation is Class 2. It is not suitable for public collecting due to the scarcity of fossils and the nature of the matrix (hard) in which they are found.

#### Minturn Formation (Pennsylvanian)

The Minturn Formation is a white to light gray and greenish-gray sandstone containing conglomerates, siltstones, black shales, limestones, and some gypsum. It has a gradational contact with the underlying Sharpsdale Formation, and it reaches a thickness of about 3,000 feet near La Veta Pass. Depositional environments varied from marine to non-marine coastal plains and deltas. The Minturn Formation contains three members. However, the Whiskey Creek Pass Member is the only fossiliferous member.

There are four known localities in the Minturn (Appendix I). Fossils collected from these localities and the Minturn in general include plants, trilobites, corals, sponges, fusulinids, gastropods, bivalves, brachiopods, and forams (Berg, 1967; Bolyard, 1959; Brill, 1952; Munger, 1959; Tischler, 1963 - Table 6). The fauna

Table 6: Species of the Minturn Formation.

## Coelenterata

Caranina sp.  
Fenestella cf. F. placida  
Lophophyllidium conoideum  
Pseudozaphrentoides lepidus  
Rhombopora lepidodenderoides  
Subcoretepora sp.

## Brachiopoda

Antiquatonia portlockiana  
Chanetina flamingi  
Cleiothyridina orbicularis  
Composita cf. ovatus  
C. subtilita  
Derbyia cf. D. crassa  
D. cf. D. crassa var. richmonda  
Desmoinesia muricata  
Dictyoclostus coloradoensis  
D. harmosanus  
D. portlockianus  
Dielasma bovidens  
Echinocanchus samipunctatus  
Fusitina rockymontanus  
Hustadia mormoni  
Juresania nebrascensis  
Limproductus af. L. prattenianus  
Lingula sp.  
Linoproductus meniscus  
Marginifera haydenensis  
M. ingrata  
M. wabashensis  
M. sp.  
Mesolobus mesolobus  
Neospirifer cameratus  
N. chronici  
N. dunbari  
N. cf. N. triplicatus  
Orbiculoden capuliformis  
Phricodothvris perplexus  
Punctospirifer kentuckyensis  
Schuchertella sp.  
Spirifer occidentalis  
S. cf. S. rockymontanus  
Wedekindellina

## Gastropoda

Anomphalus? sp.  
Bucanopsis sp.  
Casseletina? sp.  
Glabrocingulum sp.

Table 6 continued.

Goniasma copei  
Ianthinopsis paludaeformis  
I. regularis  
Meekospira peracuta var. choctawensis  
Pharkidonatus sp.  
Pictyceras sp.  
Piocazyga sp.  
Strabeus? sp.  
Trachydomia nadosa  
T. whitei  
T. sp.  
Worthenia tabulata

## Bivalvia

Allorisma terminale  
Astartella concentrica  
Aviculopecten occidentalis  
A. sp.  
Corrallites? sp.  
Cypricardina carbonaria  
Nucula? sp.  
Nuculana attenuata, n. sp.  
Nuculopsis girtyi

## Ostracoda

Bythocypris sp.  
Cavellina cf. C. pulchella  
Hastifaba pervulata  
Jonesina arcuata  
Sulvella sulcata

## Bryozoa

Fenestella cf. F. placida  
Polypora sp.  
Rhombopora lepidodenderoides  
Sulcoretepora sp.

## Bellerophonitida

Cymatospira montfortianus  
Euphemites carbonarius  
E. nodocarinatus  
Pharkidonotus percarinatus

## Trilobita

Amerura sangamonensis  
Ditomopyge parvulus  
D. sp.



Table 6 continued.

Corals

Caninia torquia  
C. sp.  
Chaeteras cf. C. favosus  
Lophophyllidium conoideum  
Pseudozaphrentoides lepidus  
P. cf. P. lepidus  
Stereostylus cf. S. cages  
Syringopora sp.

Foraminifera

Fusulina distenta  
F. novamexicana  
F. rockymontana  
F. socorroensis

Arthropoda

Ditomopyge sp.

Crinoidea

Erisocrinus typus  
Schistocrinus ovalis  
Ulocrinus sp.

Flora

Calamites sp.  
Lepidodendron

is varied and relatively abundant. The formation is designated as Class 2.

## Jurassic

### Jurassic Sediments

Outcrops of Jurassic formations occur in the study area near Beulah, in the far northeastern corner of Pueblo County, around the Greenhorn Anticline, and on the eastern flanks of the Sangre de Cristo Mountains. They also occur in the canyons of the major rivers flowing into the Arkansas River. Total thickness of these outcrops is about 350 feet.

### Entrada Sandstone (Jurassic)

The Entrada Sandstone is an upper Jurassic formation that is comprised of gray to buff, thick- to massive-bedded, fine- to medium-grained quartzose sandstone. The grains are frosted and cross-bedding occasionally occurs. The Entrada unconformably overlies the Sangre de Cristo Formation. The depositional environment is at least partially eolian. No fossils have been reported from this formation in the study area. Footprints have been found, however, near Grand Junction. The formation is designated as Class 3 based on the scarcity or complete lack of fossil remains.

### Ralston Creek Formation (Jurassic)

The Ralston Creek Formation is comprised of yellow to gray limestone, silty calcareous shales, and fine-grained sandstone with gypsum and jasper as characteristic components. It overlies the Entrada Formation, and it reaches a thickness of approximately 30 feet. Few exposures are seen in the study area.

No fossils have been reported from the study area. However, Scott (1963) reported freshwater gastropods and algae from the Ralston Creek Formation along the Front Range. The formation is designated Class 3 due to the lack of fossil material.

Morrison Formation (Upper Jurassic)

The Morrison Formation consists of variegated shales, claystones, and siltstones. The common colors are gray, red, buff, and greenish-gray. It also contains fine-grained pink-gray sandstones. The Morrison overlies the Ralston Creek Formation and reaches a thickness of 200 to 300 feet. The depositional environment was one of a lowland floodplain with freshwater lakes and low energy streams.

No fossils have been reported from the study area but elsewhere the formation contains significant dinosaur remains. It also contains freshwater molluscs and fish, crocodiles, turtles, lizards, birds and terrestrial molluscs (Branson, 1935; Carpenter, pers. comm.; Stose, 1912 - Table 7). The Morrison is designated as Class 2. It requires more study based on the amount of vertebrate remains that have been recovered from the formation elsewhere.

Table 7: Species of the Morrison Formation.

## Plantae

Aclistochara bransoni  
A. complanata  
A. latisulcata  
Araucarioxylon sp.  
Obtusochara madloni  
Praechara voluta  
P. symmetrica  
Sellatochara obovata

## Bivalvia

Unio felchi  
U. iridoides  
U. lapilloides  
U. macropisthus  
U. stewardi  
U. toxonotus

## Gastropoda

Amplivalvata cyclostoma  
A. scabrida  
Lymnaea ativuncula  
L. morrisonensis  
L. consortis  
Mesauriculstra accelerata  
M. morrisonensis  
M. m. ovalis

## Ostracoda

Darwinula leguminella  
Cypris purbeckensis  
Metacypris bradyi  
M. forbesi  
M. whitei

## Osteichthyes

Ceratodus guntheri

## Chelonía

Glyptops plicatulus

## Crocodylia

Eutretauranosuchus delfsi  
Goniopholis felix

Table 7 continued.

## Dinosauria

Allosaurus fragilis  
Apatosaurus sp.  
Camarasaurus supremus  
Ceratosaurus nasicornis  
Coelurus agilis  
Diplodocus longus  
Haplocanthosaurus priscus  
H. utterbackii  
Labrosaurus ferox  
Othniela rex  
Stegosaurus armatus?  
S. stenops

## Mammalia

Docodon sp.  
Kepolestes coloradoensis

## Lower Cretaceous

### Purgatoire Formation

The Purgatoire Formation consists of white to buff cross-bedded sandstones with thin beds of black shale and dark gray shale (Johnson, Wood, and Harbour, 1958). It lies disconformably over the Morrison Formation. The Purgatoire is divided into two members, the lower Lytle and the upper Glencairn Shale.

The Lytle Member is a white to gray massive coarse-grained conglomeratic sandstone. The grains are composed of quartz and chert. The upper Glencairn Shale Member consists of dark shales and siltstones interbedded with thin brown sandstones (Cobban, 1956). Thin beds of coal are sometimes present.

No fossils have been reported from the study area but marine invertebrates including bivalves and ammonites have been found along the Front Range (Scott, 1963; Stose, 1912; Waage, 1953). In the upper portion of the Glencairn foraminifera, sponge spicules, and a bivalve species have also been found (Waage, 1953). Fossils found are early Cretaceous but at least part of the Purgatoire is thought to be Jurassic. Based on the invertebrate species which have been collected from the Purgatoire in the immediate region, and on the need to further refine the age of the formation, more study is needed. The formation is designated as Class 2. A species list for the Purgatoire Formation is found in Table 8.

### Dakota Sandstone (Lower to Upper Cretaceous)

The Dakota Sandstone is exposed in the study area as cliffs in

Table 8: Species of the Purgatoire Formation.

## Ammonoidea

Acanthoceras sp.  
Prionotropis sp.  
Turritiles sp.

## Bivalvia

Avicula sp.  
Cardium kansasense  
Cyprina sp.  
Gryphaea corrugata  
Inoceramus comancherus  
I. fragilis  
Leda sp.  
Leptosolen conradi  
Ostrea quadriculata  
O. sp.  
Pecten? sp.  
Pholadomya cf. sancti-sabae  
Protocardia multilineata  
P. texana  
P. sp.  
Tapes sp.  
Trigonia emoryi  
T.? sp.

## Brachiopoda

Lingula sp.

## Gastropoda

Turritella seriation-granulata  
T. whitei

## Vertebrata

osteichthyes, indet.



river canyons and as hogbacks around the Wet and Sangre de Cristo Mountains. The formation is a massive fine to medium gray quartz sandstone that weathers to a rusty brown. It generally forms two ledges separated by thin black carbonaceous shales. The Dakota is the accumulation of strandline deposits of the advancing Cretaceous Sea, and it unconformably overlies the Purgatoire Formation. It ranges in thickness, in the study area, from 225 to 350 feet.

There are no recorded fossil sites within the study area. However, remains from outside the area include trace fossils, plants, and foraminifera (Chamberlain, 1976; Cobban, 1956; Gilbert, 1897; Stose, 1912; Waage, 1953 - Table 9). Dinosaur footprints have also been found in the hogback near Morrison in the southeast section of Colorado (P. Robinson, pers. comm.).

Table 9: Species of the Dakota Formation.

## Plantae

Sterculia lugubris?Sequoia reickenbacki

## Animalia

ArenicolitesAsterosoma-TeichichnusChomatichnusChondritesCochlichnusCorophoidesDiplocraterionOphiomorphaPhycosiphonPlanolitesRhizocoralliumRosseliaScoyeniaSkolithosTeichichnusTerebellinaThalassinoidesTrichichnus

## Upper Cretaceous

### Graneros Shale (Lower and Upper Cretaceous)

The graneros Shale was deposited by the advancing upper Cretaceous Sea and lies conformably on the Dakota Sandstone. It is typically dark gray to black non-calcareous shale with thin layers of bentonite. The Thatcher Limestone Member rests between lower and upper shale members (Kauffman, 1977). It is a dense, dark gray limestone that weathers to a rusty brown. The Graneros Shale ranges in thickness from 105 to 380 feet.

Fossils are uncommon in the lower Graneros and consist mostly of forams, fish parts, and worm burrows (Scott, 1969b; Stose, 1912). The upper portion of the shale has a more varied faunal assemblage. The ammonite Acanthoceras is common (Scott, 1969b). Bivalves and gastropods are also represented (Johnson, 1930a) and forams are abundant (Eicher, 1965). Table 10 lists the species collected from the Graneros. There are many known localities within the study area (Appendix I). The Graneros Shale is designated as Class 2 due to the abundance of species and the many localities found within the study area.

### Greenhorn Limestone (Upper Cretaceous)

The Greenhorn Limestone conformably overlies the Graneros Shale. It is more resistant than the Graneros and forms ridges or ledges where they are both exposed. The Greenhorn is made up of alternating beds of dense gray limestone and light gray calcareous shales. Three members are recognized. They are, oldest to youngest, the Lincoln

Table 10: Species List for the Graneros Shale.

## Ammonoidea

Acanthoceras amphibolum  
A. granerosense  
A. johnsoncerum  
A. muldoonense  
A. cf. A. rhotomagensis  
A. cf. A. tarrantense  
A. wintoni  
A. sp.  
Arisoceras cf. A. plicatile  
Boressiakoceras compressum  
B. cf. B. orbiculatum  
B. sp.  
Calycoceras gilberti  
C. (Conlinoceras) gilberti  
C. leonense  
C. sp. A.  
C. sp.  
?C. sp.  
Coilopeoceras novimexicanum  
Desmoceras sp.  
D. (Pseudouhligella) sp.  
Epengonoceras dumbli  
Eumophaloceras cf. E. cunningtoni  
E. lonsdalei  
E. cf. E. lonsdalei  
Forbesiceras? sp.  
Idiohamites sp.  
Johnsonites sulcatus  
Mammites sp.  
Prionotropis sp.  
Stomohamites cf. S. simplex  
Stomohamites sp.  
Tarrantoceras notatile  
T. startoni  
Turrilites actus americanus  
T. (Euturrilites) scheuchzerianus  
T. (E. sp.  
T. sp.

Table 10 continued:

## Bivalvia

Anomia  
Arca sp.  
Breviarca sp.  
Cametonectes  
Coibula nematophora  
Crassatellia excavata  
Exogyra columbella  
E. sp.  
Gryphaea newberry  
Inoceramus belvuensis  
I. cf. I. belvuensis  
I. eulessarus  
I. fragilis  
I. rutherfordi  
I. sp.  
Leda sp.  
Limatula sp.  
Lucina sp.  
Nuculama? sp.  
Ostrea beloiti  
O. cf. O. beloiti  
O. congesta  
O. noctuensis  
O. soleniscus  
O. sp.  
Pecten (Comptonectes) cf. P. cavanus  
P. sp.  
Plicatula arenaria  
Veniella mortoni

## Foraminifera

Lenticulina gaultina  
Praebulinina wyomingensis  
Trochommina apricarius  
T. gatesensis  
T. rutherfordi mellariolum  
Verneuilinoides perplexus

## Gastropoda

Actaeon sp.  
Arrrhoges modesta  
Cinulia sp.  
Diploconcha? sp.  
Turritella cf. T. thompsonia  
T. whitei  
T. sp.

Limestone, the Hartland Shale and the Bridge Creek. All members are fossiliferous.

The Lincoln Limestone Member consists of a bentonite layer and a very thin calcarenite bed composed of broken shells of Ostrea beloiti. Overlying these, the main Lincoln sediments are calcareous shales and some thin layers of bentonite (Scott, 1963 and 1969b). Two faunal zones are present in the Lincoln Limestone Member. The lower zone is characterized by Inoceramus rutherfordi and Ostrea beloiti. Associated ammonites are Acanthoceras amphibolum and Tarrantoceras and Turritiles species. The upper zone is characterized by Inoceramus pictus and Ostrea elegantula, and associated ammonite Calycoceras canitaurinum (Scott, 1963). Foraminifera are abundant (Scott, 1969b).

The Hartland Shale Member is composed mainly of gray fissile calcareous shale with calcarenite, limestone, and bentonite layers (Scott, 1963, 1969b). Fossil fragments are abundant, however, well preserved specimens are rare (Scott, 1969b). Inoceramus pictus and Calycoceras species are most diagnostic of this level. Thalmaninella greenhornensis has also been identified (Scott, 1963). Fossil shells of forams are abundant (Scott, 1969b).

The Bridge Creek Limestone Member contains gray, hard, finely crystalline limestone beds separated by thicker beds of bluish-gray calcareous shale (Scott, 1963, 1969b). Fossils are abundant and diverse in the limestone beds; they are also present in the shale beds but more difficult to recover (Scott, 1969b). The Bridge Creek is divided into three faunal zones. The lower zone

is characterized by Inoceramus pictus and the associated ammonites Sciponoceras gracile, Allocrioceras parienne, Kanabicerias septemseriatum, and Metioceras whitei. The fish species Apsepelx sauriformis is also present. The middle zone contains Inoceramus pictus and a Kanabicerias species. The upper zone contains Inoceramus labiatus and the ammonites Mammites nodosoides and a Baculites species. A more complete species list is given in Table 11.

The Bridge Creek Limestone Member of the Greenhorn Limestone represents the maximum transgression of the Cretaceous Sea in the Western Interior during Greenhorn deposition (Kauffman et al., 1969). It is interesting to note that Eicher (1969) estimated the sea depth at 3,000 feet based on slope measurements and microbios while Hattin (1975) and Kauffman (1977) estimated it at a maximum of 300 to 660 feet based on sedimentary features and macrobios.

There are many known localities in the Greenhorn Limestone (Appendix I). The formation is given a Class 2 designation based on its rich fauna and its stratigraphic correlations.

#### Carlile Shale (Upper Cretaceous)

The Carlile Shale gradationally overlies the Greenhorn Formation, reaching a maximum thickness of 250 feet. It is divided into four members which are, oldest to youngest, Fairport Chalky Shale Member, Blue Hill Shale Member, Codell Sandstone Member, and Juana Lopez Member.

The Fairport Chalky Shale Member consists of pale yellowish-brown, light olive gray, or gray shales, and it weathers to clayey calcareous

Table 11: Species List for the Greenhorn Limestone.

## Ammonoidea

Acanthoceras amphibolum  
A. coloradoense  
A. cf. A. coloradoense  
A. granerosense  
A. kanabense  
A. muldoonense  
Allocrioceras annulatum  
A. pariense  
Ampakalistes colligoni  
Anisoceros sp.  
Baculites calamus  
B. gracilis  
B. cf. B. yokoyamai  
B. sp.  
Belemnitella baculus  
Calycoeras canitaurinum  
C.? canitaurinum  
C. (Conlinoceras) gilberti  
C. leonense  
C. cf. C. naviculare  
C. sp.  
C.? sp.  
Choffaticeras pavillieri  
C. sp.  
C.? sp.  
Collignonoceras woollgari  
C. sp.  
C. ? sp.  
Fagesia sp.  
Helicoceras corrugatum  
H. pariense  
Hemiptychoceras reesidei  
Kanaboceras puebloense  
K. septemseriatum  
K. sp.  
Mammites nodosoides wingi  
M. nodosoides  
M. sp.  
Metioceras cf. M. defordi  
M. sp.  
Neoptychites cf. N. cephalstus  
Pachydissus sp.  
Prionotropis loevianus  
P. sp.  
Puebloites corrugatus.  
P. greenhornensis  
P. spiralis  
P. sp.



Table 11 continued.

Pseudocalvoceras dentonense  
 P. sp.  
Radiolites sp?  
Scaphites sp.  
Sciporioceras gracile  
 S. sp.  
Stomohamites cf. S. simplex  
 S. sp.  
 S.? sp.  
Tarrantoceras sp.  
Tragodesmoceras bassi  
Turrilites sp.  
Vasoceras (Greenhornoceras) birchbyi  
V. birchbyi  
Watinoceras coloradoense  
W. reesidei  
Worthoceras gibbosum vermiculum  
W. gibbosum  
W. vermiculum

## Bivalvia

Anomia sp.  
Camptonectes sp.  
Corbula hanabensis  
C. nematophora  
Dorax cuneata  
D. oblonga  
Entolium sp.  
Exogyra cf. E. boveyensis  
E. laeviuscula  
Inoceramus flavus  
I. ginterensis  
I. labiatus  
I. labiatus var. subhercynica  
I. labiatus var.  
I. pictus  
I. cf. I. pictus  
I. rutherfordi  
I. subconvexus  
I. sp.  
Modolia multilinigera  
Mytiloides labiatus  
Nucula sp.  
Ostrea alta  
O. beloiti  
O. congesta  
O. sp.  
O. sp.?



Table 11 continued.

Pheloptera sp.

Phelopteria

Pholadeomya papyracea

Pteria sp.

Pynodonte newberryi

Syncyclonema sp.

Chondrichthyes

Ptychodus sp.

silt. Fossils are abundant and well known although many are often preserved only as impressions in shale and calcarenite beds. They include bivalves, ammonites, and forams (Dane, Pierce, and Reeside, 1936; Eicher, 1966; Eicher and Worstell, 1970; Kauffman and Pope, 1961; Scott, 1969b - Table 12).

The Blue Hill Shale Member is a black, fissile, non-calcareous shale which contains sandy shale and large calcareous concretions. Fossil remains, which are uncommon and poorly preserved, contain ammonites, bivalves including a large species of oyster, many gastropods, and forams (Eicher, 1966; Kauffman and Pope, 1961; Scott, 1969b - Table 12).

The Codell Sandstone Member is exposed as a resistant cliff or ledge in many places. It is a light colored, yellowish to gray fine-grained sandstone with some concretions. It is highly bioturbated and sometimes cross-bedded. The Codell Sandstone contains abundant and well known fossil material including ammonites, bivalves, and gastropods (Kauffman and Pope, 1961; Scott, 1969b). Bryozoans, annelids, echinoids, crustaceans, and vertebrates occur as minor faunal elements (Kauffman and Pope, 1961). Forams are present but not nearly as abundant as in the Fairport and Blue Hill Members (Eicher, 1966). The gastropod Pugnellus fusiformis is especially abundant, forming 52 to 91 percent of the fauna in any one lens in Huerfano Park (Kauffman and Pope, 1961). It is also abundant in all Codell Sandstone outcrops of the Western Interior from Canon City southward and is used as a geographic indicator

Table 12: Species List for the Carlile Shale.Ammonoidea

Bacculites sp.  
Collignonicer hyatti (poorly preserved and rare)  
Collignonicer woollgari  
Crionotropis woollgari  
Haminea truncata  
Placenticer pseudoplacenta  
Prionocyclus macombi  
P. wyomingensis  
P. woollgari  
Prionotropis hyatti  
P. woollgari  
Scaphites carlileensis  
S. larvaeformis  
S. warreni  
S. whitfieldi

Bivalvia

Anatina lineata  
Anomia subquadrata  
Arca sp.  
Avicula gastrodes  
Cardium pauperculum  
C. sp.  
Cassidulus stantoni  
Corbula atophora  
Crassostrea soleniscus  
Cubitostrea malachitensis  
C.? malachitensis  
Cymbophora emmonsii  
Ensis? sp.  
Exogyra suborbiculata  
Gervillia propoleura  
Inoceramus cuvieri  
L. costellatus  
L. dimidiatus  
L. aff. L. dimidiatus  
L. flaccidus  
L. fragilis  
L. gilberti  
L. howelli  
L. labiatus  
L. cf. L. labiatus  
L. perplexus  
L. sp.  
Lopha bellaplicata novamexicana

Table 12 continued.

Lucina juvenis  
Mactra emmonsii  
M. huerfanensis  
M. sp.  
Mytiloides labiatus  
M. hercynicus  
M. subhercynicus  
M. latus  
Ostrea bentonensis  
O. congesta  
O. aff. O. congesta  
O. lugubris  
O. malachitensis  
O. sp.  
Pheloptera sp.  
Pholadomya coloradoensis  
Pinna petrina  
Solemya obscura  
Tellina whitei  
Trigonarca obliqua  
Veniella mortoni  
Yoldia subelliptica

## Gastropoda

Actaeon propinquus  
Cancellaria malachitensis  
Fasciolaria utahensis  
Fusus venenatus  
Gryphaea sp.  
Gyrodes conradi  
G. depressa  
Liopistha concentrica  
Pugnellus fusiformis  
Pyropsis coloradoensis  
Ringicula angusta, n. sp.  
Ringicula codellana, n. sp.  
R. sp.  
Turritella whitei  
T. sp. aff. T. whitei  
Volutoderma cumbiera  
V. dalli  
V. gracilis  
V. placatula  
V. willistonii  
Xenophora simpsoni  
 Gastropod sp.

Table 12 continued.

## Foraminifera

Ammobaculites macellus  
Ammomarginulina perimpexus  
Clavibembicella simplex  
Gaudryina bentonensis  
G. spiritensis  
Gavelinella dakotensis  
Globotruncana marginata  
Haplophragmoides howardense  
H. kirkii  
Hedbergella delrioensis  
H. planispira  
Heterohelix globulosa  
Lenticulina kansasensis  
Lunatriella spirifera  
Miliammina ischnia  
Neobulimina albertensis  
Planulina kansasensis  
Praeglobotruncana renzi  
P. stephani  
Pseudoclavulina haetata  
Reophax inordinatus  
Rugoglobigerina? aprica  
Saccamina alexanderi  
Spiroplacetamina acostai  
Texlukeria? sp.?  
Trochammina ribstonensis  
T. wickendeni  
Trochamminoides apricarius  
Valvulineria loetterlei  
 Foram. spp.

## Chondrichthyes

Odontoaspis macrota  
Plicatolamna arcuata  
Ptychodus whipplei  
Scapanorhynchus raphiodon  
Squalicnax falcatus

## Annelida

Serpula plana  
 Annelid spp.

## Crustacea

Stramentum sp.

(Kauffman, pers. comm.). In addition the Codell Sandstone is noted for the variety of sharks teeth found in the lag concentration on the top of the member (P. Robinson, pers. comm.).

The Juana Lopez Member is a light gray shaly fine-grained sandstone containing lenses of calcarenite with a petroliferous odor. Fossils are abundant and include ammonites, bivalves, fish scales and teeth, and fucoids (Table 12).

Specific localities within the Carlile Shale are listed in Appendix I. Cobban (1956), Scott (1964), and Stose (1912) provided species lists for the Carlile Shale which outcrops in the study area and in the immediate vicinity (southeastern Colorado).

#### Niobrara Formation (Upper Cretaceous)

The Niobrara Formation outcrops extensively in the study area. It reaches a maximum thickness of approximately 700 feet and is considered to be a deep offshore marine deposit. The Niobrara has two members. The oldest is the Fort Hays Limestone Member, and the youngest is the Smoky Hill Member.

In the study area, the Fort Hays Limestone Member is comprised of light gray to yellow chalky limestones interbedded with their chalky shale and a thin layer of bentonite. The sediments are resistant and form ridges and cliffs. This member is thin, reaching a thickness of 40 feet. It is disconformable with the underlying Carlile Shale (Scott and Cobban, 1964). Fossils consist of Ostrea congesta, three Inoceramus species, and rare fragments of ammonites. There are three faunal zones based on the Inoceramus species. Forams are also present (Hills, 1900).



The overlying Smoky Hill Member consists of light gray chalky shales and thin limestones which weather to a characteristic yellow orange (Scott and Cobban, 1964). The outcrops are less resistant than the Fort Hays and form gentle slopes. This member reaches thicknesses of approximately 500 to 700 feet in the study area. Fossil remains are more varied than in the Fort Hays limestones. The Smoky Hill is divided into seven units each containing different associations of ammonites and bivalves (Scott and Cobban, 1964). Species for the entire Niobrara Formation are listed in Table 13. Appendix I lists the several localities that are found in the study area.

#### Pierre Shale (Upper Cretaceous)

The Pierre Shale gradationally overlies the upper member of the Niobrara Formation. In the Walsenburg area and in Huerfano Park the Pierre reaches a thickness of approximately 2,000 feet. Two unnamed members, an upper sandstone and a lower dark shale, are recognized in this area. Five members have been described in the vicinity of Pueblo (Scott, 1969b). They are, oldest to youngest, a transition member, Apache Creek Member, Sharon Springs Member, Rusty Zone, and Tepee Zone.

The transition member consists of buff and gray shales and thin fossiliferous sandstones and limestones. In the lower part of the member fossils occur as impressions. It is characterized by fish scales, smooth baculites, and the bivalve Inoceramus simpsoni. The upper portion of the transition zone is characterized by a weakly

Table 13: Species List from the Niobrara Formation.

## Ammonoidea

Baculites asper  
B. codvensis  
B. cf. haresi  
B. sp. (smooth)  
B. sp. (smooth, small)  
B. sp.  
Barroisiceras (Forresteria) hobsoni  
Clinoscaphites choteauensis  
C. saxitonianus  
C. vermiformes  
Haresiceras placentiforme  
H. sp.  
Neocrioceras, n. sp.  
Placenticeras planum  
Prionocycloceras? sp.  
Protexanites shoshonensis  
Pseudobaculites sp.  
Radiolites austiniensis  
Scaphites binneyi  
S. depressus  
S. d. var. stantoni  
S. hippocrepsis  
S. ventricosus  
Stantonoceras pseudocostatum  
Texanites americanus

## Arthropoda

Stramentum haworthi

## Bivalvia

Anomia subquadrata  
Corbula nematophora  
Inoceramus confertim-annulatus?  
I. cordiformes  
I. deformis  
I. erectus  
I. involutus  
I. cf. patootensis  
I. cf. perplexus  
I. platinus  
I. undulatopticatus  
I. stantoni  
I. umboratus  
I. sp.  
I. (volvicceramus) involutus  
Lucina sp.

## Table 13 continued.

Ostrea congestaO. soleniocus

## Gastropoda

Turritella whitei

## Crustacea

Tracks of small crustaceans

## Miscellaneous

Fish scales and teeth

Shark teeth

## Foraminifera

Globigerina sp.Textularia sp.

ribbed baculite (Baculites aff. B. obtusus), the bivalve Inoceramus aff. I. cycloides, fragments of the chirocentrid fish Ichthyodectes and plant fragments (Scott, 1969b).

The Apache Creek Member consists of dark gray shales with thin lenses of fine-grained sandstones. Concretions are abundant in several layers, and in some form persistent ledges that are easily correlated in different localities (Scott, 1969b). Well-preserved fossils are rare. A weakly ribbed species of Baculites, earlier than B. obtusus, and Inoceramus agadjakendensis characterize this member. The skull and some vertebrae of a mosasaur identified as Platyacarpus cf. P. crassartus by Edward Lewis of the U.S.G.S. was found approximately six miles north of Pueblo (Scott, 1969b).

The Sharon Springs Member is comprised of hard black fissile shales with many large septarian concretions. The member contains abundant fossils and is divided into five baculite zones. Fossils include several ammonite and baculite species, bivalves, many of which are found in the limestone concretions. In addition, parts of a mosasaur were uncovered, and a plesiosaur, Polycotylus latipinnis, was collected from the lower part of the member (Cobban and Scott, 1964; Scott, 1969b).

The Rusty Zone is a dark gray shale containing ironstone and limestone concretions (Scott, 1969b). A lower shale unit contains very little fossil material, while there are abundant fossils in the upper part (Griffiths, 1949; Scott, 1969b). The Rusty Zone can be divided into three baculite zones (Scott, 1969b).

The Tepee Zone consists of olive gray shales with limestone concretions, ironstone concretions, and large masses of limestone.

The zone gets its name from the conical shape of the limestone masses in the area (Scott, 1969b). Fossils are abundant and diverse, and the strata are broken down into four ammonite zones. The zones are characterized by an association of ammonites and bivalves peculiar to each zone (Scott, 1969b).

The Pierre Shale has been divided into faunal zones also, some of which are equivalent with those of its members (Scott, 1963; Scott and Taylor, 1974b, Washburn, 1910). Scott (1963) provides a comprehensive stratigraphic distribution of Pierre fossils by ammonite zones. These zones and their characteristic faunas have been widely used in correlating Pierre sediments both within and out of the study area.

There are many known localities in the Pierre Shale within the study area. These are listed in Appendix I. The species that have been collected from the Pierre Shale are listed in Table 14. The Pierre is given a Class 2 designation.

#### Trinidad Formation (Upper Cretaceous)

The Trinidad Formation sandstones intertongue with the pro-deltaic sands of the upper Pierre Shale in the Walsenburg vicinity of the study area. It exhibits depositional characteristics of a deltaic front, a channel, and a beach and dune. Maximum thickness reached by the Trinidad Formation is 300 feet; it thins to the southeast. These sandstones are buff to gray, fine- to medium-grained, and slightly arkosic. Some thin tan to gray silty shales are present. The formation outcrops as steep ledges.

Table 14: Species List for the Pierre Shale.

## Ammonoidea

Acanthoscaphites nodosus var. pleniusA. n. var. brevisA. n. var. quadrangularisAcanthoscaphites sp.Anapachydiscus complexusBaculites asperiformesB. aff. asperiformesB. baculusB. claviformesB. clinolobatusB. compressusB. eliasiB. grandisB. gregoryensisB. jenseniB. mclearniB. obtususB. obtusus (early form)B. aff. obtususB. ovatusB. ovatus var. haresiB. perplexusB. pseudovatusB. reesideiB. rugosusB. scottiB. undatusB. older sp.Delawarella daneiDidymoceras chevennenseD. nebrasenseD. stevsoniDiscoscaphites cf. abyssinusD. chevennensisD. conradiD. mandanensisD. cf. nicolletiD. sp.Exiteloceras jenneviE. oronenseHamites sp.Helioceras sp.Heteroceras nebrascenseH. sp.Hoploscaphites gilliH. nodosusH. sp.

Table 14 continued.

Menuites sp.  
Nostoceras sp.  
Placentoceras intercalcare  
P. meeki  
P. placenta  
Oxybeloceras crassum  
O. sp.  
Scaphites nodosus  
Solenoceras crassum  
S. mortoni  
S. cf. mortoni  
Sphenodiscus lenticularis  
Trachyscaphites praespiniger  
Turrulites sp.

## Nautiloidea

Eutrephoceras dekayi  
E. sp.

## Bivalvia

Anisomyon borealis  
Anomia raetiformis  
Crassatella sp.  
Cucullae sp.  
Cymbophora canonensis  
C. holmesi  
Inoceramus agdjakendensis  
I. altus  
I. balchii  
I. barabini  
I. convexus  
I. aff. I. cycloides  
I. incurvis  
I. oblongus  
I. perenuis  
I. proximus  
I. sagensis  
I. saskatchewanensis  
I. simpsoni  
I. subcircularis  
I. subcompressus  
I. subaevis  
I. tenuilineatus  
I. typicus  
I. vanuxemi  
I. sp.

Table 14 continued.

Lingula sp.  
Lucina occidentalis  
Lucina sp.  
Mactra canonensis  
M. gracilis  
M. sp.  
Nucula cf. N. fibrosus  
N. larimerensis  
N. planimarginata  
N. sp.  
Ostrea falcata  
O. inornata  
O. patina  
O. pellucida  
O. plumosa  
Panopaea berthoudi  
Phelopteria linguaeformis  
P. sp.  
Pinna lakesii  
Pteria nebrascana  
P. sp.  
Solemya bilix  
Synsyclonema nigida  
Tellina seitula  
Thracia gracilis  
Variella humilis  
Volselfa meekii

## Gastropoda

Anchura americana  
Anisomyon borealis  
A. centrale  
A. patelliformis  
Capulus spangeri  
Fasciolaria ?cf. F. chevennensis  
F. culbertsoni  
Cyrodes abyssina  
G. crenata  
Margarita nebrascensis  
Turritella sp., probably new  
Volutoderma clatworthyi  
V. sp.

## Ostracoda

Yoldia evansi  
Y. scitula  
Y. sp.



Table 14 continued.

Coleoidea

Belemnitella bulbosa

Scaphopod

Dentalium gracile

Foraminifera

Robulus sp.

Trace Fossil

Ophiomorpha

Annelida

Serpula? sp.

Osteichthyes

Ichthyodectes sp.

Reptilia

Platycarpus cf. P. crassartus

P. sp.

Prognathodon crassartus

Trinacromerum sp.

Tylosaurus proniger

Fossil remains are not abundant. Pillmore and Maberry (1976) cited several trace fossils of which Ophiomorpha is the most abundant. It can be used to identify the Trinidad. Lee (1922) reported marine invertebrates, predominantly bivalves and leaves, from this formation. Fischer (1980) stated that many of the species listed by Lee (1917) as Trinidad fauna probably belong to the upper Pierre.

There are no known localities from this formation. Those species mentioned above are listed in Table 15. The formation is designated as Class 2.

#### Vermejo Formation (Upper Cretaceous)

The Vermejo Formation is composed of a repetitive sequence of buff, gray, and dark gray siltstones, buff, gray, and gray-green slightly arkosic sandstones, black carbonaceous silty shale, and numerous coal beds. It rests conformably on the Trinidad Formation. It reaches a maximum thickness of 500 feet and thins from Walsenburg to the southeast. Johnson and Wood (1956) interpret the Vermejo sediments as a delta plain deposit. Haun and Weimer (1960) noted that an erosional interval was created at the top of the Vermejo by an initial phase of the Laramide Orogeny in the late Cretaceous.

The fossil plant remains of the Vermejo Formation have received much study. Fisher (1980) noted that Knowlton's (1917) work on the Vermejo flora is the primary source of information although his taxonomy has been extensively revised. Among the angiosperms

Table 15: Species List for the Trinidad Formation.

## Bivalvia

Anomia? sp.  
I. barabini  
I. sagensis  
Lucina  
Mactra warreniana  
M. sp.  
Ostrea pellucida  
O. sp.  
Panopaea? sp.  
Tellina scitula  
T. sp.

## Holothursidea

Avicula nebrascana

## Reptilia

Mosasaurus sp.

## Trace fossils

Asterosoma  
Aulichnites  
Desmograption  
Diplocraterion  
Ophiomorpha  
Teichichnus  
Thalassinoides  
 furoid impressions

## Miscellaneous

Leaves of land plants

in Knowlton's flora are fig, willow, magnolia, grape, walnut, oak, laurel, sycamore, beech, honeysuckle, and palm. The gymnosperms include conifers, cypress, fir and fern. Clarke (1966) described fossil pollen from the Vermejo, and Scott and Taylor (1974b) mentioned brackish water marine invertebrates. These remains suggest a non-seasonal, temperate to subtropical climate. The Vermejo flora is listed in Table 16. There are two known localities in the study area (Appendix I). The Vermejo is designated as Class 2 and may be suitable for public collecting is properly managed.

#### Raton Formation (Upper Cretaceous)

The Raton Formation consists of a basal layer of thin sandy quartz and chert-pebble conglomerate. Above this basal layer lie alternating beds of buff, gray, and olive gray arkoses, sandstones, siltstones, silty shales, and numerous coal beds. These lithologies reflect deposition in swamps, rivers, and floodplains. The Raton reaches a maximum thickness of 1,700 feet but in some areas it is less than 100 feet. The Raton, Vermejo, and Trinidad deposits are exposed on the eastern edge of the northern Raton Basin and record the regression of the late Cretaceous Sea and the resultant environmental change from pro-deltaic to fully terrestrial channel and flood plain deposition.

Fossil remains from the Raton Formation in Colorado have been studied by Knowlton (1917) and revised by Brown (1962). Fischer (1980) noted that the flora contained oak, walnut, cottonwood, sycamore, magnolia, ferns, and palms. The flora is present

Table 16: Species List for the Vermejo Formation.

## Flora

Abietites dubius  
Artocarpus dissecta  
Brachyphyllum cf. B. macrocarpum  
Chondrites bulbosus  
C. subsimplex  
Calerpires incrassatus  
Asplenium? coloradense  
Cupressinoxylon coloradense  
Canna magnifolia  
Credneria protophylloides  
Colutea speciosa  
Celtrus? sp.  
Cissites panduratus  
Diospyros? leei  
Ficus haddeni  
F. leei  
F. minima  
F.? starkvillensis  
F. praetrinervis  
F. speciosissima  
F. wardii  
F. gigantea  
Fraxinum? sp.  
Geinitzia formosa  
Hedera rotundifolia  
Myrica torreyi  
Pteris russellii  
P. erosa  
P.? sp.  
Populus neomexicana  
Phaseolites minutus  
Pterospermites undulatus  
P. wardii  
P. nervosus  
Paleocaster inquirenda  
Phyllites aurantiacus  
P. leei  
P. nanus  
P. populoides  
P. rosaefolius  
P. sapindus  
P. walsenburgensis  
P. vermejoensis  
P. ratonensis

Table 16 continued.

Quercus gardneri  
Rosellinites lapideus  
Rhamnus salicifolius  
Sequoia reichenbachii  
S. obovata  
Sabal montana  
S.? ungeri  
Salix gardneri  
S. plicata  
S. sp. A and sp. B  
Sterculia coriacea  
Taxodium? sp.  
Viburnum anomalinerus  
V. montanum  
V. crassum  
V. rhamnifolium  
Vitis? sp.  
Woodwardia crenata  
Widdringtonia? complanata  
Zizyphus palurifolius  
  
Liriodendron alatum  
Sparganium? sp.

throughout the formation except for the basal conglomerate. It is interesting to note that the Cretaceous-Paleocene boundary is defined by changes in the paleoflora as it is not lithologically discernable.

There are no known fossil localities in the study area. The species list for the Raton Formation is found in Table 17. The formation is designated as Class 2 based on the important floral remains. It might be possible to develop some judicious plan for public collecting.

Table 17: Species List for the Raton Formation.

## Flora

Allantodiopsis erosa  
Blechnum anceps  
Dryopteris lakesi  
Lastrea goldiana  
Anemia elongata  
Isoetes horridus  
Alismaphyllites grandifolius  
Chamaedora danae  
Paleoreodoxites plicatus  
Sabal grayana  
Sabal imperialis  
Sabal powelli  
Carya antiquorum  
Juglans berryana  
Castanea intermedia  
Artocarpus lessigiana  
Ficus affinis  
Ficus artocarpoides  
Ficus minutidens  
Ficus planicostata  
Ficus uncata  
Platanus nobilis  
Platanus raynoldsi  
Laurophyllum caudatum  
Laurophyllum perseanum  
Laurus socialis  
Persea brossiana  
Nymphaea leei  
Cercidiphyllum articum  
Magnolia berryi  
Magnolia magnifolia  
Magnolia regalis  
Magnolia rotundifolia  
Eucommia serrata  
Prunus coloradensis  
Staphylea minutidens  
Acer fragile  
Rhamnus goldiana  
Zizyphus fibrillosus  
Cissus marginata  
Cissites rocklandensis  
Vitis olriki  
Pterspermites cordatus  
Nyssa alata  
Apocynophyllum lesquereauxi



Table 17 continued.

Phyllites pogoensis

Carpolithes spinosus

Palmocarpon commune

Palmocarpon compositum

Roots with Rootlet scar pits

Fossil wood

## Tertiary

### Poison Canyon Formation (Paleocene)

The Poison Canyon Formation outcrops in Huerfano Park and southeast of Walsenburg in the northern portion of the Raton Basin. Lithologically the formation is composed of alternating beds of buff to red massive arkosic sandstones and conglomerates. Large boulders attest to increased uplift of the source areas to the south- and northwest (Tweto, 1980). Thin beds of shale and coal lenses are occasionally present. The underlying Raton Formation grades vertically and horizontally into the Poison Canyon. This inter-tonguing indicates a period of contemporaneous deposition. The Poison Canyon may also overlie the Vermejo or Pierre Formations due to a variable erosional interval.

Poison Canyon fossils are not common. Some well preserved plant remains are found in coal lenses. Briggs and Goddard (1956) described these plants as a tropical flora. Lee (1917) lists several species which he stated were collected from the Poison Canyon Formation. Fischer (1980) suggested that some of the specimens may have come from the Raton but noted that the flora of lower Poison Canyon is almost indistinguishable from that of the upper Raton.

There are no known localities within the study area. Those species reported for outlying areas are listed in Table 18. The formation is designated Class 2.

Table 18: Species List for the Poison Canyon Formation.

## Flora

Cornus studei?  
Euphorbocarpum richardsoni  
Ficus richardsoni  
Lauries socialis  
Magnolia laurifolia  
Palmocarpus sp.  
Platanus guillemae  
Rhamnus cleburni  
Zizyphus fibrillosus

Cuchara Formation (Eocene)

The Cuchara Formation outcrops from West Spanish Peak north to Huerfano Park. It consists of red, pink, and white thin to massive sandstone and thin red and tan shales. The Cuchara unconformably overlies the Poison Canyon Formation in most cases but may also overlies older formations back to the Pierre Shale. It reaches a maximum thickness of 5,000 feet in the center of the Raton Basin. These are basin-fill sediments derived from Paleozoic and younger rocks exposed by the San Luis uplift to the west.

Fossils of the Cuchara Formation include creodonts, condylarths, pantodonts, carnivores, primates and perissodactyls (Robinson, 1960, 1963, 1966 - Table 19). The formation is important scientifically and is designated as Class 1-b. There are several known localities in the study area and these are noted in Appendix I.

Huerfano Formation (Middle to Late Eocene)

The Huerfano Formation occurs south and west of West Spanish Peak and in Huerfano Park where it weathers to a badlands topography. The sediments consist of variegated maroon, gray, and green shales, and red, white, and tan sandstone. The latter sandstone is near the base of the formation and forms resistant cliffs in some places. The Huerfano unconformably overlies the Cuchara, Poison Canyon, and Pierre Formations, and in some places intertongues laterally with the Cuchara. It reaches a maximum thickness of 2,000 feet.

The Huerfano Formation in Huerfano Park has produced a variety of vertebrate fossils. These include rodents, marsupials, primates

Table 19: Species List for the Cuchara Formation.

## Carnivora

Didymictis cf. D. protenus

## Condylarthra

Hyopsodus wortmaniPhenacodus intermedius

## Creodonta

Sinopa cf. S. vulpecula

## Pantodonta

Coryphodon sp.

## Perissodactyla

Hyracotherium sp. either H. angustidens or H. vasaccenseLambdaotherium popoagicum

## Primates

Cynodontomys knightensis

carnivores, condylarths, artiodactyls, and perissodactyls (Robinson, 1966). The localities in this area are considered scientifically significant. Kihm and Middleton (1980) noted that the fossils collected in the park are transitional between the Wasatchian and Bridgerian. P. Robinson (pers. comm.) returns to Huerfano Park about every other year to collect. The Huerfano Formation is designated as Class 1-b based on its importance to paleontology. Those species which have been collected from localities that lie within the park (Appendix I) are listed in Table 20.

#### Farisita Formation (Middle Eocene to ?Oligocene)

The Farisita Formation is exposed on the south and west side of the West Mountains in Huerfano Park. Outcrops are discontinuous and scarce in the study area. Lithologically this formation is composed of coarse buff conglomerates and siltstones. The conglomerates are poorly sorted and cemented. Precambrian clasts, from pebble size to boulders 8 feet in diameter, indicate resurgent uplift in the adjacent Wet Mountains. The Farisita reaches a thickness of up to 1,200 feet.

Farisita fossils are uncommon and poorly preserved (Johnson, 1959; Robinson, 1966). The Farisita unconformably overlies the Huerfano Formation and, where erosion has taken place, successively older formations back to the Precambrian. The Farisita also intertongues with the Huerfano Formation in Huerfano Park (Robinson, 1966). Fossils collected by Robinson (1966) date the Farisita in Huerfano Park as Eocene. However, within the study area the Farisita also extends

Table 20: Species of the Huerfano Formation.

## Marsupialia

Peratherium cf. P. comstockii

## Insectivora

Apatemys lg. sp.A. sm. sp.Diacodon or Paleictops sp.Nyctitherium cf. N. veloxPalaeictops bicuspisScenopagus edenensisS. priscusTalpavus cf. T. nitidus

## Primates

Absarokius noctivagus noceraeCynodontomys scottianusC. scottianus?Huerfanius rutherfordiLoveina zephyriMicrosyops lundeliusiNotharctus nunienusPhenacolemur jepsoni simpsoniShoshonius cooperi

## Tillodontia

Esthonyx acutidensTrogosus grangeriT. hillsi

## Taeniodonta

Stylinodon sp.

## Edentata

Metacheiromys sp.

## Rodentia

Leptotomus costilloiL. grandisL. parvusMicroparamys sp. BParamys copei copeiP. excavatus gardneriReithroparamys huerfanensisThisbomys nini

## Carnivora

Didymictis altidensD. cf. D. protenusD. vancleveaeMiacis cf. M. parvivorius?Oodectes herpestoidesOxyaena cf. O. lupina

## Table 20 continued.

Sinopa cf. S. strenua  
Uintacyon cf. U. asodes  
Viverravus gracilis  
V. sicarius  
Vulpavus asius

## Creodonta

Patriofelis paulus  
 ?P. sp.

## Condylartha

Hyopsodus paulus  
H. walcottianus  
Phenacodus wortmani

## Dinocerata

Bathyopsis cf. B. fissidens

## Pantodonta

Coryphodon sp.

## Perissodactyla

Eotitanops borealis  
E. minimus  
Helaletes cf. H. nanus  
 ?Heptodon sp.  
Hyrachyus modestes  
Hyrachotherium craspedotum  
H. vasacciense  
Lambdotherium popoagium  
Palaeosyops fontinalis  
Xenicohippus osborni

## Artiodactyla

Antiacodon pygmaeus huerfanensis  
Bunophorus cf. B. macropternus  
Diacodexis chacensis  
D. cf. secans



Eocene sediments and these beds are generally figured to be younger. Fossil remains would be helpful in dating the Parisita Formation. The area is designated as 1-b. Those fossils that have been collected are listed in Table 21 and the known localities in the study area are noted in Appendix I.

Devil's Hole Formation (?Miocene)

The sediments of the Devil's Hold Formation consist of waterlaid volcanic rocks which contain pebbles of Precambrian gneiss and schist (Johnson and Wood, 1956). It varies in thickness from 25 to 1,300 feet. Outcrops in the study area occur only in the north-central part of Huerfano Park.

Fossils are rare. The only reported specimen is the gastropod Helix? cf. H.? leidyi from the collections of the University of Colorado Museum. The Devil's Hole Formation is designated Class 3.

Table 21: Species list for the Farisita Formation.

Amblypoda  
Coryphodon sp.

Artiodactyla  
Bunophorus macropterrus

Carnivora  
Viverravus gracilis

Condylarthra  
Hyopsodus walcottianus

Edentata  
Metacheiromys sp.

Perissodactyla  
?Heptodon sp.  
Hyracotherium sp.  
Lambdaotherium sp.

Primates  
Cynodontomys scottianus

## Quaternary

### Quaternary Deposits

Quaternary deposits consist of alluvial sands and gravels, and occur in stream channels and valley flats throughout the study area. Due to variable lithologies, descriptions and ages of strata are not possible without field studies and/or associated fossils.

Vertebrates of Pleistocene to Holocene age are reported randomly throughout the study area. They include proboscideans, horses, camels, bison, edentates, and rodents (Carpenter and Boston, 1980). They are not a predictable part of any certain formation and are therefore not classified in this report. It should be noted, however, that even though vertebrate fossil sites are not abundant, and specimens are poorly preserved, they can be useful for age determination and every effort should be made to see that the proper agencies are notified of new discoveries. These deposits are provisionally designated Class 3 where they outcrop on BLM land. Table 23 is a list of species found in Quaternary deposits.

Table 22: Species List for Quaternary Deposits

## Artiodactyla

Bison latrifronsBison sp.Camelops sp.?Ovibos sp.

## Edentata

Paramylodon sp.

## Perissodactyla

Equus sp.

## Proboscidea

Mammut sp.Mammuthus columbiM. imperatorM. jeffersoniM., n. sp.

## Rodentia

Cynomys hibbardi?Spermophilus sp.

# BIBLIOGRAPHY

- Beck, Henry V. 1956. Geology near Beulah, Colorado. Guidebook to the Geology of the Raton Basin, Colorado. Rocky Mt. Assoc. Geol.:50-51.
- Berman, A.E., D. Podeschook Jr., T.E. Dimelou. 1980. Jurassic and Cretaceous systems of Colorado. Pp. 111. In: Colorado Geology. Rocky Mountain Association of Geologists Symposium. Kent, H.C. and K.W. Porter, eds.
- Berner, R. and L.D. Briggs. 1958. Continental Eocene sedimentation in Huerfano Park, Colorado. (Abstract). G.S.A. Bull. 69:1533.
- Blanco, S.R. 1971. Geology of the Rye-Colorado City area, Pueblo and Huerfano Counties, Colorado. Unpubl. M. S. Thesis, Colorado School of Mines.
- Bolyard, D. W. 1959. Pennsylvanian and Permian stratigraphy in the Sangre de Cristo Mountains between La Veta Pass and Westcliffe (Custer and Saguache Counties), Colorado. Am. Assoc. Pet. Geol. Bull. 43: 1896-1939.
- \_\_\_\_\_. 1960. Permo-Pennsylvanian stratigraphy in the Sangre de Cristo Mountains, Colorado. In: Guide to the Geology of Colorado. Rocky Mountain Association of Geologists; Denver. Pp. 121-126.
- Brainard, A.E., H. R. Baldwin, and I. A. Keyte. 1933. The pre-Pennsylvanian stratigraphy of the Front Range in Colorado. A.A.P.G. Bull. 17:375-396.
- Branson, C. C. 1935. Freshwater invertebrates from the Morrison (Jurassic?) of Wyoming. J. Paleol. 9:514-522.
- Briggs, L.I., Jr. and E.N. Goddard. 1956. Geology of Huerfano Park, Colorado. Guidebook to the Geology of the Raton Basin, Colorado. Pp. 40-45 (inc. map). Rocky Mountain Association of Geologists, Denver.
- Brill, K. G. 1952. Stratigraphy in the Permo-Pennsylvanian zeugogeosyncline of Colorado and northern New Mexico. G. S. A. Bull. 63:809-880.
- Brock, M. R. and O. Dryer. 1968. Geologic map of the Mount Tyndall Quadrangle, Austen County, Colorado. U. S. G. S. Map GQ-596.
- Bryant, W. L. and J. H. Johnson. 1936. Upper Devonian fish from Colorado. J. Paleol. 10:656-659.

- Cannon, G. L., Jr. 1890. Notes on the formations in eastern Colorado. Colo. Sci. Soc. Proc. 3:215-216.
- \_\_\_\_\_. 1892. Notes on a discovery of Radiolites aystrinensis. Colo. Sci. Soc. Proc. 4:75-76.
- Carpenter, K. and P. J. Boston. 1980. Paleontological resources of Fort Carson, Colorado. Grand River Consultants, Inc., Grand Junction, Colorado.
- Chamberlain, C. K. 1976. Fieldguide to the trace fossils of the Cretaceous Dakota Hogback along Alameda Ave., west of Denver, Colorado. P. 242. In: Studies in Colorado Field Geology. Prof. Contr. of Colorado School of Mines # 8, Epis, R. C. and R. S. Weimer, eds.
- Chapin, C. E. and R. C. Epis. 1964. Some stratigraphic and structural features of the Thirtynine Mile Volcan Field, central Colorado. The Mt. Geol. 1:145-160.
- Chronic, J. 1958. Pennsylvanian paleontology in Colorado. Symposium on Pennsylvanian Rocks of Colorado and Adjacent Areas. Rocky Mount. Assoc. Geol.:13-16.
- \_\_\_\_\_. 1964. Geology of the Southern Mosquito Range, Colorado. The Mt. Geol. 1:103-113.
- Chronic, J. and H. Chronic. 1972. Prairie, Peak and Plateau: A Guide to the Geology of Colorado. Colo. Geol. Surv. Bull. 32.
- Clarke, R. T. 1965a. Fungal spores from Vermejo Formation coal beds (upper Cretaceous) of central Colorado. Mt. Geol. 2:85-93.
- \_\_\_\_\_. 1965b. Palynology of the Vermejo Formation coal of upper Cretaceous age of central Colorado. G.S.A. Spec. Pap. 87:281.
- Cobban, W. A. 1951. Scaphitoid cephalopods of the Colorado group. (Benton and Niobrara). U.S.G.S. Prof. Pap. 239. 42pp.
- \_\_\_\_\_. 1956. The Pierre Shale and older Cretaceous rocks in southeastern Colorado. Rocky Mt. Geol. Assoc. Guidebook 1956:25-27.
- \_\_\_\_\_. 1958. Two new species of Baculites from the western interior region. J. Paleol. 32:660-665.
- \_\_\_\_\_. 1962. New baculites from the Bearpaw Shale and equivalent rocks of the western interior. J. Paleol. 36:126-135.
- \_\_\_\_\_. and J. B. Reeside, Jr. 1952. Correlation of the Cretaceous formations of the western interior of the United States. G.S.A. Bull. 63:1011-1043.
- \_\_\_\_\_. and G. R. Scott. 1964. Mulinodose scaphitoid cephalopods from the lower part of the Pierre Shale and equivalent rocks in the conterminous United States. U.S.G.S. Prof. Pap. 483-E. 13pp.

- Cobban, W. A. and G. R. Scott. 1972. Stratigraphy and ammonite fauna of the Graneros Shale and Greenhorn Limestone near Pueblo, Colorado. U.S.G.S. Prof. Pap. 645. Pp. 108. 39 plates.
- Cobban, W. A., G. R. Scott, and J. R. Gill. 1962. Recent discoveries of the Cretaceous ammonite Haresiceras and their stratigraphic significance. U.S.G.S. Prof. Pap. 450-B: 58-60.
- Conrad, T. A. 1875. The Vertebrata of the Cretaceous formations of the west. U.S.G.S. Terr. Rept. 2:23-24.
- Cramer, J. A. 1962. The Jurassic Ralston formation in the southern Colorado Front Range. Unpubl. M.S. thesis. Kansas State University.
- Creely, R. S. and A. O. Saterdal. 1956. Ojo anticline, Huerfano County, Colorado. Pp. 68-70. Guidebook to the Geology of the Raton Basin, Colorado. Rocky Mt. Assoc. Geol., Denver.
- \_\_\_\_\_. 1956b. Badito-Alamo area, Huerfano County, Colorado. Pp. 71-74. Guidebook to the Geology of the Raton Basin, Colorado. Rocky Mt. Assoc. Geol., Denver.
- Cress, W. 1894. U.S.G.S. Geol. Atlas, Pikes Peak Folio (no. 7).
- Dane, C. H., W. G. Pierce, and J. B. Reeside, Jr. 1937. The stratigraphy of the upper Cretaceous rocks north of the Arkansas River in eastern Colorado. U.S.G.S. Prof. Paper 186-K:207-232.
- Darton, N. H. 1904. Comparison of the stratigraphy of the Black Hills Bighorn Mountains and Rocky Mountain Front Range. G.S.A. Bull. 15: 394-401.
- DeVoto, R. H. 1964. Stratigraphy and structure of Tertiary rocks in southwestern South Park. Mt. Geol. 1:117-126.
- \_\_\_\_\_, R. H. Frederick, A. Perl and W. Pierce. 1971. Pennsylvanian and Permian stratigraphy, tectonism and history, northern Sangre de Cristo Range, Colorado. Guidebook of the San Luis Basin, Colorado, New Mexico Geol. Soc. Ann. Field Conf. Guideb. No. 22:141-163.
- DeVoto, R. H. 1980a. Mississippian stratigraphy and history of Colorado. P. 57. In: Colorado Geology. Rocky Mt. Assoc. Geol. Symp. Kent, H.C. and K.W. Porter, eds.
- DeVoto, R. H. 1980b. Pennsylvanian stratigraphy and history of Colorado. P. 71. Colorado Geology. Rocky Mt. Assoc. Geol. Symp. Kent, H.C., and K.W. Porter, eds.

- DeVoto, R. H. and F. A. Peel. 1972. Pennsylvanian and Permian stratigraphy and structural history, northern Sangre de Cristo Range, Colorado. P. 283. In: Paleozoic stratigraphy and structural evolution of Colorado, a symposium. R. H. DeVoto, ed. Quarterly of the Colo. School of Mines. Vol. 67.
- Eicher, D. L. 1969. Paleobathymetry of Cretaceous Greenhorn Sea in eastern Colorado. A.A.P.G. Bull. 53:1075-1090.
- \_\_\_\_\_. 1965. Foraminifera and biostratigraphy of the Graneros Shale. J. Paleo. 39:875-909.
- \_\_\_\_\_. 1966. Foraminifera from the Cretaceous Carlile Shale of Colorado. Cushman Foundation Foram. Res. Contr. 17:16-31.
- \_\_\_\_\_. and P. Worstell. 1970. Lunatriella, a Cretaceous heterohelical foraminifer from the western interior of the United States. Micropaleo. 16:117-212.
- Emmons, S. F. J.D. Irving and G. F. Loughlin. 1927. Geology and ore deposits of the Leadville Mining District, Colorado. U.S.G.S. Prof. Pap. 148. 368 pp.
- Ettinger, M. 1964. Geology of the Hartsel area, South Park County, Colorado. Mt. Geol. 1:127-132.
- Finlay, G. S. 1907. The Gleneyrie Formation and its bearing on the age of the Fountain Formation in the Manitou region, Colorado. J. Geol. 15:586-589.
- Fischer, D.W. 1980. Paleontological Inventory and Assessment of the Trinidad Known Recoverable Coal Resource Area. Bureau of Land Management, Contract No. CO-050-PHO-159. 36 pp.
- Fisher, C. A. 1906. Description of the Nepesta Quadrangle. U.S.G.S. Folio.
- Flower, R. H. 1952. Cephalopods from the Harding and Manitou Formations of Colorado. J. Paleo. 26:505-518.
- Frederickson, E. A. 1961. Pre-Pennsylvanian rocks of the Canon City area. Symposium on lower and middle Paleozoic rocks of Colorado. Rocky Mt. Assoc. Geol.:133-142.
- \_\_\_\_\_. and J. M. Pollack, 1952. Two trilobite genera from the Harding Formation (Ordovician) of Colorado. J. Paleo. 26:641-644.



- Gerhard, L. C. and M. Anson. 1968. First days road log. Southwest from Pueblo to northeast flank of Wet Mountains, study of Paleozoic and Mesozoic section from Beulah to Canon City area, return to Pueblo. Guidebook issue, southeastern Colorado. Mt. Geol. 5:154-164.
- Gerhard, L. C. 1974. Redescription and new nomenclature of Manitou Formation, Colorado. A.A.P.G. Bull. 58:1397-1402.
- Gilbert, G. K. 1897. Pueblo Quadrangle, Colorado. U.S.G.S Geol. Atlas, Folio 36.
- Girty, G. H. 1903. The Carboniferous formations and faunas of Colorado. U.S.G.S Prof. Pap. 16. 546 pp.
- Glockzin, A. R. and C. J. Roy. 1945. Structure of the Red Creek area, Fremont County, Colorado. G.S.A. Bull. 46:819-927.
- Grose, L. T. 1960. Geologic formations and structure of Colorado Springs area, Colorado. P. 188. In: Guide to Geology of Colorado. G.S.A. and R.M.A.G. Guidebook. Weimer, R. J. and J. Haun, eds.
- Griffitts, M. L. O. 1949. Zones of Pierre formation of Colorado. A.A.P.G. Bull. 33:2011-2028.
- Harbour, R. L. and G. H. Dixon. 1956. Geology of the Trinidad-Aquilar areas. Las Animas and Huerfano Counties, Colorado. U.S.G.S. Oil Invest. Map. OM-174.
- Harnes, J. C. 1964. Structural history of the southern Front Range. Mt. Geol. 1:93-101.
- Haun, J. D. 1959. Lower Cretaceous stratigraphy of Colorado. Rocky Mt. Assoc. Geol. Symp. on Cretaceous rocks of Colorado and adjacent areas: 1-8.
- \_\_\_\_ and R.J. Weimer. 1960. Cretaceous stratigraphy of Colorado. P. 58. In: Guide to the Geology of Colorado. G.S.A. and R.M.A. G. Guidebook. Weimer, R.J. and J.D. Hauns, eds.
- Heaton, R. L. 1939. Contribution to Jurassic stratigraphy of Rocky Mountain regio. A.A.P.G. Bull. 23:1153-1177.
- Hills, R. C. 1889a. The field for original work on the Rocky Mountains. Colo. Sci. Soc. Proc. 3:168-184.
- \_\_\_\_. 1889b. The recently discovered Tertiary beds of the Huerfano River Basin. Colo. Sci. Soc. Proc. 3:148-164.
- \_\_\_\_. 1890. Additional notes on the Huerfano beds. Colo. Sci. Soc. Proc. 3:217-223.

- Hills, R. C. 1891. Remarks on the classification of the Huerfano Eocene. Colo. Sci. Soc. Proc. 4:7-9.
- \_\_\_\_\_. 1899. Description of the Elmers Quadrangle (Colorado). U.S.G.S. Atlas, Folio 58. 6 pp.
- \_\_\_\_\_. 1900. Description of the Walsenburg Quadrangle (Colorado). U.S.G.S. Geol. Atlas, Folio 68. 6 pp.
- \_\_\_\_\_. 1901. Description of the Spanish Peaks Quadrangle (Colorado). U.S.G.S. Geol. Atlas. Folio 71. 7pp.
- Hollick, C.A. 1894. A new fossil Liriodendron from the Laramie at Walsenburg and its significance. Am. Geol. 14:203.
- \_\_\_\_\_. 1902. Fossil ferns from the Laramie Group of Colorado. Terrey. 2:145-148.
- Imlay, R. W. 1945. Occurrence of middle Jurassic rocks in western interior of United States. A.A.P.G. Bull. 29:1019-1027.
- \_\_\_\_\_. 1952. Correlation of the Jurassic Formations of North America, exclusive of Canada. G.S.A. Bull. 63:953-992.
- Johnson, J. H. 1930a. The Benton fauna of eastern Colorado and Kansas and its recorded geologic range. J. Paleo 4:193-196.
- \_\_\_\_\_. 1930b. Unconformity in Colorado group in eastern Colorado. A.A.P.G. Bull. 14:789-794.
- \_\_\_\_\_. 1934. Paleozoic formations of the Mosquito Range, Colorado. U.S.G.S. Prof. Pap. 185-B:15-43.
- \_\_\_\_\_. 1935. Stratigraphy of northeastern and east central parts of South Park, Colorado. A.A.P.G. Bull. 19:1339-1356.
- \_\_\_\_\_. 1945. Resume of the Paleozoic stratigraphy of Colorado. Colo. School Mines Quart. 40:20-29.
- Johnson, R. B. 1958. Geology and coal resources of the Walsenburg area, Huerfano County, Colorado. U.S.G.S. BULL. 1042-0:557-583.
- \_\_\_\_\_. 1959. Geology of the Huerfano Park area, Huerfano and Custer Counties, Colorado. U.S.G.S. Bull. 1071-D:87-119.
- \_\_\_\_\_. 1961. Coal resources of the Trinidad coal field in Huerfano and Las Animas Counties, Colorado. U.S.G.S. BULL 1112-E:129-180.

- Johnson, R. B. 1962. The Ralston Creek (?) Formation of late Jurassic age in the Raton Mesa region and Huerfano Park, south-central Colorado. U.S.G.S. Prof. Pap. 450-C:49-54.
- \_\_\_\_\_. 1968. Geology of the igneous rocks of the Spanish Peaks region, Colorado. U.S.G.S. Prof. Pap. 594-G:1-47 and map.
- \_\_\_\_\_ and E. H. Balty, Jr. 1960. Probable Triassic rocks along eastern front of Sangre de Cristo Mts, south-central Colorado. A.A.P.G. Bull. 44:1895-1902.
- \_\_\_\_\_ and J.G. Stephens. 1954a. Geology of the La Veta area, Huerfano county, Colorado. U.S.G.S. Oil and Gas Invest. Map OM 146.
- \_\_\_\_\_. 1954b. Coal resources of the La Veta area, Huerfano County, Colorado. U.S.G.S. Coal Invent. Map. C-20.
- \_\_\_\_\_. 1955. Geologic map of the Walsenburg area, Huerfano County, Colorado. U.S.G.S. oil Invest. Map. OM-161.
- Johnson, R. B. and G. H. Wood Jr. 1956. Stratigraphy of upper Cretaceous and Tertiary rocks of Raton Basin, Colorado and New Mexico. A.A.P.G. Bull. 40:707-721.
- Johnson, R. B., D.W. Bolyard and W. R. Thurston. 1969. Second days' road log- Walsenburg to Black Hills, Gardner Pass Creek, Russell, La Veta Pass, La Veta, Aucharas Pass, Apishipa Pass, Aguilar, Walsenburg. Mt. Geol 6:166-182.
- Johnson, R. B., G. H. Dixon and A. A. Wanek. 1956. Late Cretaceous and Tertiary stratigraphy of the Raton Basin of New Mexico and Colorado. Guidebook of Southeastern Sangre de Cristo Mountains, New Mexico, 7th Annual Field Conference:122-133.
- Johnson, R. B. G. H. Wood, Jr. and R. L. Harbour. 1958. Preliminary geologic map of the northern part of the Raton Mesa region and Huerfano Park in parts of Las Animas, Huerfano, and Custer Counties, Colorado. U.S.G.S. Oil Invest Map. OM 183.
- Johnson, R. B. 1969. Geologic map of the Trinidad Quadrangle, south-central Colorado. U.S.G.S. Map I-558.
- Jurie, C. A. and L.C. Gerhard. 1969. Colorado Raton Basin: Mineral resources and geologic section. Mt. Geol. 6:81-84.
- Kauffman, E. G. 1967. Coloradan macroinvertebrate assemblages, central western interior, United States. In: Paleoenvironments of the Cretaceous seaway in the Western Interior. A Symposium. Colorado School of Mines Pub., preprints of papers for G.S.A. Rocky Mt. Sec. 20th Ann. Mtg, Golden: 67-143.

- Kauffman, E. G. 1977. Geological and biological overview: Western interior Cretaceous basin. *Mt. Geol.* 14:75-99.
- \_\_\_\_ and J. K. Pope. 1961. New species of *Ringicula* from the upper Cretaceous of Huerfano County, Colorado, and remarks on the Pugnellus sandstone: (Codell Sandstone Member, Carlile Shale). *J. Paleo.* 35: 1003-1013.
- \_\_\_\_, J. D. Powell, and D. C. Hattio. 1969. Cenomanian-Turonian facies across the Raton Basin. *Mt. Geol.* 6:93-118.
- Keruner, G. et al. 1966. Lexicon of Geologic Names of the United States. for 1936-1960. Parts 1-3. U.S.G.S. Bull. 1200.
- Keyes, C. R. 1934. Taxonomic status of Greenhorn limestone. *Pan-Am. Geol.* 62:305-308.
- \_\_\_\_ 1940. Early Cretacic Purgatoire Formation of southeastern Colorado. *Pan-Am. Geol.* 74:301-303.
- Kihm, A.J. and M.D. Middleton. 1980. Tertiary vertebrate biostratigraphy of Colorado. P. 157. In: Colorado Geology. Rocky Mt. Assoc. Geol. Symposium. Kent, H. C. and K. W. Porter, eds.
- Kim, O. J. 1951. Geology of the Wetmore- Beulah area. Custer and Pueblo Counties, Colorado. Unpubl. Master's thesis. Colorado School of Mines.
- King, N. R. 1973. Unconformable contact between Ft. Hays Limestone member and Smoky Hill Shale member of Niobrara Formation and coeval strata (upper Cretaceous) in Colorado and northern New Mexico (Abstract). *G. S.A. Abstr.* 5:488-489.
- Kirk, S. R. 1929. Conodonts associated with the Ordovician fish forms of Colorado: a preliminary note. *Am. J. Sci.* 218:493-496.
- Kirk, E. 1930. The Harding Formation of Colorado. *Am. J. Sci.* 10: 445-547.
- Knowlton, F. H. 1917. Fossil floras of the Vermijo and Raton Formations of Colorado and New Mexico. U.S.G.S. Prof. Pap. 101:223-435.
- \_\_\_\_ 1923. Fossil plants from the Tertiary lake beds of south-central Colorado. U.S.G.S. Prof. Pap. 131:133-182.
- Krutak, P. R. 1970. Origin and depositional environment of the Codell Sandstone member of the Carlile Shale (upper Cretaceous), southeastern Colorado. *Mt. Geol.* 7:185-204.

- Lakes, A. 1905. The geology and coal deposits of the Spanish Peaks district. Min. Rep. 51:184-185.
- Lavington, C. S. 1933. Montana group in eastern Colorado. A. A. P.G. Bull. 17:397-410.
- Lee, W. T. 1901. The Morrison Formation of southeastern Colorado. J. Geol. 9:343-352.
- \_\_\_\_\_. 1902. Canyon of southeastern Colorado. J. Geogr. 1:357-370.
- \_\_\_\_\_. 1902b. Notes on the Carboniferous of the Sangre de Cristo Range, Colorado. J. Geol. 10:393-396.
- \_\_\_\_\_. 1902c. The morrison shales of southern Colorado and northern New Mexico. J. Geol. 10:36-58.
- \_\_\_\_\_. 1909. Criteria for an unconformity in the so-called Laramie of the Raton Mesca coal fields of New Mexico and Colorado. G.S.A. Bull. 20:357-368..
- \_\_\_\_\_. 1915. Relations of the Cretaceous formations to the Rocky Mountains in Colorado and New Mexico. U.S.G.S. Prof. Pap. 95-C:27-58.
- \_\_\_\_\_. 1917. Geology of the Raton Mesa and other regions in Colorado and New Mexico. U.S.G.S. Prof. Pap. 101:9-221.
- \_\_\_\_\_. 1922. Raton-Brilliant-Kochler Folio, New Mexico, Colorado. U.S.G.S. Geol. Atlas Folio 214., 1:62,500.
- LeRoy, L. W. and H. C. Schieltz. 1958. Niobrar-Pierre-boundary along Front Range, Colorado. A.A.P.G. Bull 42:2444-2464.
- Lesquereux, L. 1878. Contributions to the fossil flora of the western territories. Part 2. The Tertiary flora. U.S.G.S Report VII. 366 pp.
- Litsey, L. R. 1954. Geology of the Hayden Pass-Orient area, Sangre de Cristo Mountains (Custer, Fremont, and Saguache Counties) Colorado. Unpubl. Ph.D. thesis, University of Colorado.
- Maher, J. C. 1946. Correlation of Paleozoic rocks across Las Animas Arch in Baca, Las Animas, and Otero Counties, Colorado. A.A.P.G. Bull. 30:1756-1763.
- \_\_\_\_\_. 1950. Pre-Pennsylvanian rocks along the Front Range of Colorado. U.S.G.S. Oil and Gas Prelim Chart 39.
- \_\_\_\_\_. 1953. Permian and Pennsylvanian rocks of southeastern Colorado. A.A.P.G. Bull. 37:913-939.

- Maher, J.C. 1954. Lithofacies and suggested depositional environment of Lyons Sandstone and Lykins Formation in southeastern Colorado. A.A.P.G. Bull. 38:2233-2239.
- \_\_\_\_ and J. B. Collins. 1953. Permian and Pennsylvanian rocks of southeastern Colorado and adjacent areas. U.S.G.S. Oil Invest. Map OM 135, text.
- Malek-Aslani, M. K. 1951. Geology of the Beulah area, Pueblo County, Colorado. Unpubl. Ph.D. thesis. Colorado School of Mines.
- McLaughlin, K. P. 1952. Microfauna of the Pennsylvanian Glen Eyrie Formation, Colorado. J. Paleo. 26:613-621.
- Mitchell, J. G., J. Greene and D. B. Gould. Catalog of stratigraphic names used in the Raton Basin and vicinity. Pp. 131-135. Guidebook to the Raton Basin. Rocky Mt. Assoc. Geol., Denver.
- Mook, C. C. 1916. A study of the Morrison Formation. N. Y. A. S. Ann. 27:390-191.
- \_\_\_\_. 1933. A crocodilian skeleton from the Morrison Formation at Canon City, Colorado. AM. Mus. Novit. 671. 8 pp.
- Muller, S. G. and H. G. Schenck. 1943. Standard of the Cretaceous system. A. A. P. G. Bull. 27:262-278.
- Munger, R. D. 1959. Geology of the Spread Eagle Peak area, Sangre de Cristo Mountains, (Sawatch and Custer Counties), Colorado. Unpubl. Master's thesis, University of Colorado.
- Nadeau, J. 1972. Mississippian stratigraphy of central Colorado. Paleozoic stratigraphy and structural evolution of Colorado. Colo. School of Mines Quart. 67:77-101.
- Osborne, H. W. 1955. The Trinidad-Raton basin (Colorado, New Mexico). Field trip of the Dry Cimarron River valley, the Panhandle of Oklahoma, northeastern New Mexico, lower Front Range of the Rocky Mountains, and southeastern Colorado pp. 23-26. Panhandle Geol. Soc., Amarillo, Texas.
- \_\_\_\_. 1956. Wet Mountains and Apishapa uplift. Guidebook to the Geology of the Raton Basin, Colorado. Pp. 58-64. Rocky Mountain Assoc. Geol.; Denver.
- Ogden, L. 1958. Permian-Jurassic facies, Colorado Front Range and adjacent area; Fremont, Pueblo and El Paso Counties. Unpubl. Ph.D. dissertation, Colorado School of Mines.
- Okumura, T. A. 1976. Geology of the Lost Lake-Duling Pass area, Sangre de Cristo Mts, Colorado. Unpubl. M.S. thesis, Univ. of Colorado.

- Oriel, S. S. 1956. Problems of lower Mesozoic stratigraphy in south-eastern Colorado. Guidebook to the Geology of the Raton Basin, pp. 19-24. Rocky Mountain Assoc. Geologists, Denver.
- Patton, H. B. 1923. Merging of Carlile Shale and Timpanos Limestone Formations in southeastern Colorado. G. S.A. Bull. 34:495-498.
- Pillmore, C. L. 1969. Geologic map of the Casa Grande quadrangle. Colfax County, New Mexico and Las Animas County, Colorado. U.S.G.S. Map GQ-823.
- \_\_\_\_ and J. O. Maberry. 1976. The depositional environment and trace fossils of the Trinidad Sandstone, southern Raton Basin, New Mexico. New Mexico Geol. Soc. Guidebook, 275th Ann. Field Conf., Vermijo Park:191-197.
- Ramirez, L. M. 1974. Stratigraphy of the Mississippian System, Las Animas Arch, Colorado. Mt. Geol. 11:1-32.
- Radinsky, L. B. 1966. A new genus of early Eocene tapirid (Mammalia, Perissodactyla). J. Paleo. 40:740-742.
- Reeside, J. B. 1923. The fauna of the so-called Dakota Formation of northern central Colorado and its equivalent in southeastern Wyoming. U.S.G.S. Prof. Pap. 131-H:199-207.
- \_\_\_\_. 1929. Exogyra disuponensis Sharpe and Exogyra costata Say in the Cretaceous of the Western Interior. U.S.G.S. Prof. Pap. 154:267-278.
- Robinson, P. 1960. Fossil mammals of the Huerfano Formation (Eocene) of Colorado (Abstract). G.S.A. Bull. 71: 1957-1958.
- \_\_\_\_. 1960b. Sinopa from the Cuchara formation of Colorado. Postilla. 44:1-4.
- \_\_\_\_. 1963. Fossil vertebrates and age of the Cuchara Formation of Colorado. Univ. of Colorado Studies, Series in Geology No. 1:1-9.
- \_\_\_\_. 1966. Fossil Mammalia of the Huerfano Formation, Eocene of Colorado. Yale University, Peabody Mus. Nat. Hist. Bull. 21. 95 pp.
- Ross, C. A. 1960. Population study of charophyte species, Morrison Formation, Colorado. J. Paleo 34:717-726.
- Ross, R. A., Jr. and O. Tweto. 1980. Lower Paleozoic sediments and tectonics in Colorado. P. 47. In: Colorado Geology. Symposium. Rocky Mt. Assoc. Geol., Kent, H.C. and K. W. Porter, eds.



- Russel, D. A. 1967. Systematics and morphology of American Mosasaurs. Peabody Museum of Nat. Hist. Bull. 23:1-241.
- Sawatzsky, D. 1964. Structural geology of southeastern South Park, Park County, Colorado. Mt. Geol. 1:133-139.
- Scott, G. R. 1963. Geology of the Kassler Quadrangle, Jefferson and Douglas Counties, Colorado. U.S.G.S. Prof. Pap. 421-B:1-125.
- \_\_\_\_\_. 1964. Geology of the northwest and northeast Pueblo Quadrangles, Colorado. U.S.G.S. Misc. Geol. Inv. Map I-408, 1:24000.
- \_\_\_\_\_. 1965. Nonglacial quaternary geology of the southern and middle Rocky Mountains. Pp. 243-254. Quaternary of the United States. Princeton Univ. Press, Princeton, New Jersey.
- \_\_\_\_\_. 1969a. Geologic map of the southwest and southeast Pueblo Quadrangle, Colorado. U.S.G.S. Misc. Geol. Invest. Map I-597.
- \_\_\_\_\_. 1969b. General and engineering geology of the northern part of Pueblo, Colorado. U.S.G.S. Bull 1262:1-131.
- \_\_\_\_\_. 1972a. Reconnaissance geologic map of the Swallows Quadrangle, Pueblo County, Colorado. U.S.G.S. Map MF-354, 1:24000.
- \_\_\_\_\_. 1972b. Reconnaissance geologic map of the Hobson Quadrangle, Pueblo and Fremont counties, Colorado. U.S.G.S. Map MF-353, 1:24000.
- \_\_\_\_\_. 1972c. Reconnaissance geologic map of the Beulah N.E. Quadrangle, Pueblo County, Colorado. U.S.G.S. Map MF-352, 1:24000.
- \_\_\_\_\_. 1973. Reconnaissance geologic map of the Owl Canyon Quadrangle, Pueblo County Colorado. U.S.G.S. Map MF-547, 1:24000.
- \_\_\_\_\_. and W. A. Cobban 1962a. Apache Creek Sandstone Member of the Pierre Shale of southeastern Colorado. U.S.G.S. Prof. Pap. 475-B: 99-101.
- \_\_\_\_\_. and W. A. Cobban. 1962b. Clioscapites saxitonianus (McLearn), a discrete ammonite zone in the Niobrara Formation at Pueblo, Colorado. U.S.G.S. Prof. Pap. 450-C:85.
- \_\_\_\_\_. and W. A. Cobban. 1964. Stratigraphy of the Niobrara Formation at Pueblo, Colorado. U.S.G.S. Prof. Pap. 454-L:1-30.
- \_\_\_\_\_. and R.B. Taylor. 1973. Reconnaissance geologic map of the Beulah Quadrangle, Pueblo County, Colorado. U.S.G.S. Map MF-551. 1:24000.



- \_\_\_\_ and R. B. Taylor. 1974a. Reconnaissance geologic map of the Electric Peak Quadrangle, Custer and Saguache Counties, Colorado. U.S.G.S. Misc. Field Studies Map MF-628.
- \_\_\_\_ and R. B. Taylor. 1974B. Reconnaissance geologic map of the Rockvale Quadrangle, Custer and Fremont counties, Colorado. U.S.G.S. Misc. Field Studies Map MF-562.
- Simpson, G. G. 1926. The age of the Morrison Formation. Am. J. Sci. 12:198-216.
- \_\_\_\_. 1968. A didelphid (Marsupialia) from the early Eocene of Colorado. Postilla 115: 3 pp.
- Spath, L. F. 1941. On the boundary between the upper and lower Cretaceous. Geol. Mag. 78:309-315.
- Stanton, T. W. 1893. The Colorado Formation and its invertebrate fauna. U.S.G.S. Bull. 106:1-288.
- \_\_\_\_. 1905. The Morrison Formation and its relations with the Comanche series and the Dakota Formation. J. Geol. 13:657-669.
- \_\_\_\_. 1915. Invertebrate fauna of the Morrison Formation. G.S.A. Bull. 26:343-348.
- \_\_\_\_. 1922. Some problems connected with the Dakota Sandstone. G.S.A. Bull. 33:255-272.
- Stark, J. T. 1949. Geology and origin of South Park, Colorado. G.S.A. Mem. 33:1-177.
- Stevenson, J. J. 1879a. Preliminary report of a special geologic party operating in Colorado and New Mexico from Spanish Peaks of the south, field season of 1878. Rep. Chief. Eng., Part 3: 2249-2259.
- \_\_\_\_. 1879b. Note on the Fox Hills group of Colorado. AM. J. Sci. Ser. 3:17-369-373.
- \_\_\_\_. 1890. Remarks on the differentiation of the Colorado group in Colorado and New Mexico (with discussion). G.S.A. Bull. 1:532.
- Stokes, W. L. 1944. Morrison Formation and related deposits in and adjacent to the Colorado Plateau. G.S.A. Bull. 55:951-992.
- Stone, G. W. 1912. Description of the Apishapa Quadrangle. U.S.G.S. Geol. Atlas, Folio 186.
- Sweet, W. C. 1954. The Harding and Fremont Formations of Colorado and their fauna. Unpubl. Ph.D. Thesis, State University of Iowa.

- \_\_\_\_\_. 1954. Harding and Fremont Formations, Colorado. A.A.P.G. Bull. a38:284-305.
- \_\_\_\_\_. 1955. Cephalopods from the Fremont Formation of Central Colorado. J. Paleol. 29:71-82.
- \_\_\_\_\_. 1955b. Conodonts from the Harding Formation (Middle Ordovician) of Colorado. J. paleo 29:226-262.
- \_\_\_\_\_. 1961. Middle and upper Ordovician rocks, central Colorado. Pp. 17-24.. In: Symposium on lower and middle Paleozoic rocks of Colorado, 12th Field Conf. Rocky Mt. Assoc. Geol., Denver.
- Taylor, R. B. and G. R. Scott. 1973. Reconnaissance geologic map of the Wetmore Quadrangle, Custer and Pueblo Counties, Colorado. U.S.G.S. Misc. Field Stud. Map MF-548, 1:24000.
- Tishcler, H. 1963. Fossils, faunal zonation, and depositional environment of the Madera Formation, Huerfano Park, Colorado. J. Paleol. 37:1054-1068.
- Trexler, D. W. 1962. Coccolithophorid assemblages from the Benton and Niobrara Groups, Canon City area, Colorado (Abstract). G.S.A. Spec. Pap. 68:107-108.
- Vire, J. D. 1974. Geologic map and cross sections of the La Veta Pass and Ritter Arroyo Quadrangles, Huerfano and Costilla Counties, Colorado. U.S.G.S. Misc. Geol. Invest. Map I-833.
- Waage, K. M. 1953. Refractory clay deposits of south-central Colorado. U.S.G.S. Bull. 993.
- Walcott, C. D. 1892. Preliminary notes on the discovery of a vertebrate fauna in Silurian (Ordovician) strata. G.S.A. Bull. 3:153-172.
- Washburne, C. W. 1910. The South Park coal field, Colorado. U.S.G.S. Bull. 381:307-308.
- Weimer, R. J. 1960. Upper Cretaceous stratigraphy, Rocky Mountain area. A.A.P.G. Bull. 44:1-20.
- Weist, W. G. Jr. 1965. Geology and occurrence of ground water in Otero County and the southern part of Crowley County, Colorado. U.S.G.S. Water Supply Paper 1799. 90pp.
- White, C. A. 1879. Contributions to invertebrate paleontology No. 1: Cretaceous fossils of the western states and territories. U.S.G.S. Terr. 11th Ann. Rept.:273-319.

- \_\_\_\_\_. 1883. Contributions to invertebrate paleontology, No. 2. Cretaceous fossils of the western states and territories. U.S.G.&G. Terr. (Hayden) 12th Ann. Rept. Pt. 1:5-39.
- \_\_\_\_\_. 1886. On the fresh-water invertebrates of the North American Jurassic. U.S.G.S Bull. 29.
- Wood, G. H., Jr. and R. B. Johnson. 1951. Geology and coal resources of the Stonewall-Tercio area, Las Animas County, Colorado. U.S.G.S. Coal Inv. Map NO CH.
- Wood, G. H., Jr., R. B. Johnson and G. H. Dixon. 1956. Geology and coal resources of the Gulorare, Cuchara Pass and Stonewall area. Huerfano and Las Animas Counties, Colorado. U.S.G.S. Coal Inv. Map No. C26, 1:31,680.
- \_\_\_\_\_. 1957. Geology and coal resources of the Starkville-Weston area, Las Animas County, Colorado. U.S.G.S. bull. 1051:1-68.
- Yen, T. C. 1952. Molluscan fauna of the Morrison Formation. G.S.A. Bull. 56:1214.

Appendix I: Localities Within the Study Area.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Harding Formation</u>			
NW $\frac{1}{4}$ Sec. 5, T.23S., R.68W. Pueblo County	Sweet 1955	Conodonts	Ohio State Univ.
NE $\frac{1}{4}$ Sec. 5, T.23S., R.68W, Pueblo County	Sweet 1954	-	Univ. Co. Mus. Iowa State Univ.
<u>Fremont Limestone</u>			
NE $\frac{1}{4}$ Sec. 5, T.23S., R.68W. Pueblo County	"	-	Univ. Co. Mus. Iowa State Univ.
<u>Beulah Limestone</u>			
NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 4, T.23S., R.68W. Pueblo County			
<u>Sharpsdale Formation</u>			
*E $\frac{1}{2}$ Sec. 23, SW $\frac{1}{4}$ Sec. 24, T.27S., R.72W. Huerfano County	Bolyard 1959	Invertebrates Brachiopods	Univ. Co. Mus.
SE $\frac{1}{4}$ Sec. 21, T.28S., R.70W. Huerfano County	"	Invertebrates Fusulinids Brachiopods	"
<u>Minturn Formation</u>			
SE $\frac{1}{4}$ Sec. 21, T.28S., R.70W. Huerfano County	"	Invertebrates Brachiopods	"
East of saddle between Horn Peak and Little Horn Peak Huerfano County	"	"	"

\*Localities which are on BLM land

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Minturn Formation</u> continued			
*SW $\frac{1}{4}$ Sec. 9, T.27S., R.71W. Huerfano County	Bolyard 1959	Invertebrates	Univ. Co. Mus.
*Sec. 9, T.26S., R.71W. Huerfano County	Bolyard 1959	Invertebrates	Univ. Co. Mus.
<u>Graneros Shale</u>			
NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 36, T.20S., R.66W. Pueblo County	Cobban & Scott 1972	Ammonites	U.S. Geol. Surv. U.S. Nat'l. Mus. Univ. Texas
SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	"	"	"
SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 20, T.20S., R.65W. Pueblo County	"	"	"
NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 20, T.20S., R.65W. Pueblo County	"	"	"
SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 20, T.20S., R.65W. Pueblo County	"	"	"
NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 20, T.20S., R.65W. Pueblo County	"	"	"
SW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	"	"	"
SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 20, T.20S., R.65W. Pueblo County	"	"	"
NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 20, T.20S., R.65W. Pueblo County	"	"	"

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Graneros Shale</u> continued			
SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	Cobban & Scott 1972	Ammonites	U.S. Geol. Surv. U.S. Nat'l. Mus. Univ. Texas
NW <sup>11</sup> SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 30, T.20S, R.65W. Pueblo County	"	"	"
NE $\frac{1}{4}$ Sec. 34, T.21S., R.68W. Pueblo County	"	"	"
NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 34, T.21S., R.68W. Pueblo County	"	"	"
NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 34, T.21S., R.68W. Pueblo County	"	"	"
SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 23, T.22S., R.67W. Pueblo County	"	"	"
NW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 23, T.22S., R.67W. Pueblo County	"	"	"
NW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 23, T.22S., R.67W. Pueblo County	"	"	"
NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 18, T.22S., R.66W. Pueblo County	"	"	"
NW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 23, T.23S., R.67W. Pueblo County	"	"	"
Secs. 25 & 26, T.23S., R.66W. Pueblo County	"	"	"

Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Graneros Shale continued</u>			
Sec. 35, T.23S., R.66W. Pueblo County	Cobban & Scott 1972	Ammonites	U.S. Geol. Surv. U.S. Nat'l. Mus. Univ. Texas
NE $\frac{1}{4}$ Sec. 13, T.24S., R.65W. Pueblo County	"	"	"
N $\frac{1}{2}$ Sec. 10, T.29S., R.60W. Pueblo County	"	"	"
Sec. 31 or 32, T.20S., R.65W. Pueblo County	Scott	Ammonites	U.S. Geol. Surv.
E $\frac{1}{2}$ Sec. 25, T.20S., R.66W. and W $\frac{1}{2}$ Sec. 30, T.20S., R.65W. Pueblo County	Eicher 1965	Foraminifera	Univ. Co. Mus.
SE $\frac{1}{4}$ Sec. 5, T.27S., R.68W. Huerfano	"	"	"
SC $\frac{1}{2}$ Sec. 3, T.29S., R.60W. Las Animas County	Kauffman et al. 1969	Invertebrates	U.S. Nat'l. Mus Univ. Mich.
NW $\frac{1}{4}$ Sec. 31, T.28S., R.59W. Las Animas County	"	"	"
NW $\frac{1}{4}$ Sec. 31, T.28S., R.59W. Las Animas County	"	"	"
<u>Greenhorn Limestone</u>			
SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 18, T.18S., R.67W. Pueblo County	Cobban & Scott 1972	Ammonites	U.S. Geol. Surv. U.S. Nat'l. Mus. Univ. Texas

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Greenhorn Limestone continued</u>			
SW $\frac{1}{4}$ Sec. 20, T.18S., R.66W. Pueblo County	Cobban & Scott 1972	Ammonites	U.S. Geol. Surv. U.S. Nat'l. Mus. Univ. Texas
Sec. 2, T.19S. R.66W. Wild Horse Park Pueblo County	"	"	"
NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 35, T.20S., R.66W. Pueblo County	"	"	"
NW $\frac{1}{4}$ Sec. 25, T.20S., R.66W. Pueblo County	"	"	"
SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 25, T.20S., R.66W. Pueblo County	"	"	"
NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 25, T.20S., R.66W. Pueblo County	"	"	"
NE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 25, T.20S., R.66W. Pueblo County	"	"	"
NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 25, T.20S., R.66W. Pueblo County	"	"	"
SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 35, T.20S., R.66W. Pueblo County	"	"	"
SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 35, T.20S., R.66W. Pueblo County	"	"	"
SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 35, T.20S., R.66W. Pueblo County	"	"	"



## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Greenhorn Limestone</u> continued			
SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 25, T.20S., R.66W. Pueblo County	Cobban & Scott 1972	Ammonities	U.S. Geol. Surv. U.S. Nat'l. Mus. Univ. Texas
NE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 35, T.20S., R.66W. Pueblo County	"	"	"
SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 35, T.20S., R.66W. Pueblo County	"	"	"
NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 35, T.20S., R.66W. Pueblo County	"	"	"
SW $\frac{1}{4}$ T.20S., R.65W. Pueblo County	"	"	"
C of N $\frac{1}{2}$ N $\frac{1}{2}$ Sec. 31, T.20S., R.65W. Pueblo County	"	"	"
NW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	"	"	"
SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	"	"	"
NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	"	"	"
SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	"	"	"
SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	"	"	"

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Greenhorn Limestone</u> continued			
SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	Cobban & Scott 1972	Ammonites	U.S. Geol. Surv. U.S. Nat'l. Mus. Univ. Texas
E of C of SW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	"	"	"
SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 21S., R.66W. Pueblo County	"	"	"
NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	"	"	"
SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	"	"	"
SE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	"	"	"
SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 1, T.21S., R.66W. Pueblo County	"	"	"
SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 1 and NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	"	"	"
NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 1 and NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W Pueblo County	"	"	"
SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	"	"	"
NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 1, T.21S., R.66W. Pueblo County	"	"	"

Appendix I Continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Greenhorn Limestone</u> continued			
NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	Cobban & Scott 1972	Ammonites.	U.S. Geol. Surv. U.S. Nat'l. Mus. Univ. Texas
NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 1, T.21S., R.66W. Pueblo County	"	"	"
NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	"	"	"
NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	"	"	"
NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 1, T.21S., R.66W. Pueblo County	"	"	"
NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	"	"	"
NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 1, T.21S., R.66W. Pueblo County	"	"	"
NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 6, T.21S., R.65W. Pueblo County	"	"	"
SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 23, T.22S., R.65W. Pueblo County	"	"	"
SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 36, T.24S., R.67W. Pueblo County	"	"	"
NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 32, T.25S., R.61W. Pueblo County	"	"	"

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Greenhorn Limestone</u> continued			
Sec. 26?, T.27S., R.62W. Las Animas County	Cobban & Scott 1972	Ammonites	U.S. Geol. Surv. U.S. Nat'l. Mus. Univ. Texas
NW $\frac{1}{4}$ Sec. 7, T.28S., R.60W. Las Animas County	"	"	"
NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 35, T.20S., R.60W. Las Animas County	"	"	"
NE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 13, T.30S., R.60W. Las Animas County	"	"	"
SW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 15, T.30S., R.60W. Las Animas County	"	"	"
NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	Eicher 1966	Foraminifera	Univ. Co. Mus.
SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	"	"	"
NE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 31, T.20S., R.65W. Pueblo County	Scott	Invertebrates	U.S. Geol. Surv.
<u>Carlisle Shale</u>			
NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. Pueblo County	Eicher 1966	Foraminifera	Univ. Co. Mus.
SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 35, T.20S., R.66W. Pueblo County	"	"	"
NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 25, T.20S., R.66W. Pueblo County	"	"	"

Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Carlile Shale</u> continued			
SW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 31, T.20S., R.65W. Pueblo County	Elcher 1966	Foraminifera	Univ. Co. Mus.
NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 2, T.21S., R.66W. Pueblo County	"	"	"
*S $\frac{1}{2}$ NW $\frac{1}{4}$ Sec. 28, T.26S., R.71W. Huerfano County	Kauffman & Pope 1961	Bivalves Ammonites	Univ. Mich. Mus. Paleo.
*SW $\frac{1}{4}$ Sec. 26, T.26S., R.71W. Huerfano County	"	<u>Ringicula</u>	"
SW $\frac{1}{4}$ Sec. 30, T.20S., R.65W. and Pueblo County	Eicher & Worstell 1970	Heterohelcid	Univ. Co. Mus.
Secs. 31-34, T.28S., R59W. Las Animas County	Kauffman et al. 1969	Invertebrates	U.S. Nat'l. Mus. Univ. Mich. Mus.
Secs. 28, 29, or 30, T.28S., R.60W. Las Animas County	"	"	"
*NW $\frac{1}{4}$ Sec. 5 and NE $\frac{1}{4}$ Sec. 6, T.27S., R.68W. Huerfano County	"	"	"
*SW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 26, T.26S., R.71W. Huerfano County	"	"	"
<u>Niobrara Formation</u>			
Sec. 1, T.32S., R.62W. Las Animas County	Cobban 1951	Invertebrates	U.S. Geol. Surv.
NE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 20, T.20S., R.65W. Pueblo County	Scott 1964	<u>Inoceramus</u>	U.S. Geol. Surv. or U.S. Nat'l. Mus.

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Niobrara Formation</u> continued			
NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 26, T.20S., R.66W. Pueblo County	Scott 1964	Rudistid	U.S. Geol. Surv. or U.S. Nat'l. Mus.
E $\frac{1}{2}$ Sec. 32, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Ostrea</u> <u>Barroisiceras</u>	"
NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 5, T.21S., R.65W. Pueblo County	"	<u>Prionocycloceras</u>	"
SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 11, T.21S., R.65W. Pueblo County	"	"	"
NE $\frac{1}{4}$ Sec. 32, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Ostrea</u>	"
SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 4, T.21S., R.65W. Pueblo County	"	<u>Inoceramus</u>	"
NW $\frac{1}{4}$ Sec. 26, T.18S., R.66W. Pueblo County	"	"	"
NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 26, T.20S., R.66W. Pueblo County	"	"	"
SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 16, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Baculites</u> <u>Haploscapa</u>	"
NE $\frac{1}{4}$ Sec. 32 and NW $\frac{1}{4}$ Sec. 33, T.20S., R.65W. Pueblo County	"	The above plus <u>Ostrea</u>	"
NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 23, T.21S., R.66W. Pueblo County	"	<u>Scaphites</u>	"

Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Niobrara Formation</u> continued			
SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 16, T.20S., R.65W. Pueblo County	Scott 1964	<u>Inoceramus</u>	U.S. Geol. Surv. or U.S. Nat'l. Mus.
SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 4, T.21S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Ostrea</u>	"
SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 33, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Phlycticrioceras</u>	"
SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 61, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u>	"
SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 16, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Baculites</u> <u>Pseudobaculites</u>	"
NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 32, T.20S., R.65W. Pueblo County	"	Spiral burrows	"
NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 9, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Baculites</u>	"
SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 5, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u>	"
NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 21, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> Spiral burrows	"
NE Corner Sec. 8, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u>	"
NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 16, T.20S., R.65W. Pueblo County	"	<u>Neocrioceras</u> <u>Inoceramus</u>	"

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Niobrara Formation</u> continued			
NW $\frac{1}{4}$ Sec. 28, T.20S., R.66W. Pueblo County	Scott 1964	<u>Inoceramus</u>	U.S. Geol. Surv. or U.S. Nat'l. Mus.
NW $\frac{1}{2}$ Secs. 33, 34, and 35, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Ostrea</u>	"
SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 10, T.20R., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Ostrea</u> , <u>Baculites</u> <u>Clioscaphtes</u>	"
NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 27, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u>	"
NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 10, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Baculites</u> <u>Clioscaphtes</u>	"
NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 3, T.20S., R.65W.	"	<u>Inoceramus</u> <u>Anomia</u> , <u>Baculites</u> <u>Clioscaphtes</u>	"
NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 10, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Anomia</u>	"
MW $\frac{1}{4}$ Sec. 25, T.18S., R.66W. Pueblo County	"	<u>Inoceramus</u> , <u>Anomia</u> <u>Lucina</u> , <u>Baculites</u> <u>Clioscaphtes</u>	"
SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 10, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> , <u>Baculites</u> <u>Clioscaphtes</u>	"
NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 21, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> , <u>Pteria</u> <u>Ostrea</u> , <u>Baculites</u> <u>Clioscaphtes</u>	"



## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Niobrara Formation continued</u>			
NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 9, T.20S., R.65W. Pueblo County	Scott 1964	<u>Inoceramus</u> , <u>Pteria</u> <u>Ostrea</u> , <u>Baculites</u> <u>Clioscaphtes</u>	U.S. Geol. Surv. or U.S. Nat'l. Mus.
SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 21, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Baculites</u> <u>Scaphites</u>	"
NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 9, T.20S., R.65W. Pueblo County	"	The above plus <u>Protexanites</u>	"
SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 16, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> <u>Baculites</u> , <u>Scaphites</u>	"
NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 9, T.20S., R.65W. Pueblo County	"	<u>Scaphites</u>	"
NW $\frac{1}{4}$ Sec. 35, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u>	"
NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 3, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> , <u>Ostrea</u> <u>Baculites</u> , <u>Clioscaphtes</u>	"
NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 15, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> , <u>Ostrea</u> <u>Clioscaphtes</u>	"
NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 15, T.20S., R.65W. Pueblo County	"	"	"
NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 36, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> , <u>Baculites</u> <u>Stramentum</u>	"
NW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 15, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u>	"

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Niobrara Formation continued</u>			
SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 34, T.20S., R.65W. Pueblo County	Scott 1964	<u>Inoceramus</u>	U.S. Geol. Surv. or U.S. Nat'l. Mus.
SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 15, T.20S., R.65W. Pueblo County	"	"	"
NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 22, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> , <u>Ostrea</u>	"
SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 10, T.20S., R.65W. Pueblo County	"	"	"
SW $\frac{1}{4}$ Sec. 34, T.19S., R.65W. Pueblo County	"	<u>Inoceramus</u>	"
NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 10, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> , <u>Baculites</u> <u>Ostrea</u>	"
NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 36, T.20S., R.65W. Pueblo County	"	<u>Inoceramus</u> , <u>Baculites</u> <u>Stramentum</u>	"
NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 10, T.20S., R.65W. Pueblo County	"	<u>Clisocaphites</u> <u>Scaphites</u>	"
NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 23, T.23S., R.59W. Otero County	Cobban et al. 1962	<u>Haresiceras</u>	"
18 miles west of Pueblo near Carlile Springs on Arkansas River Pueblo County	Stanton 1893	Invertebrates	U.S. Nat'l. Mus.
SW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 26, T.206S, R.71W. Huerfano County	Kauffman et al. 1969	Invertebrates	U.S. Nat'l. Mus. Univ. Mich. Mus.

Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Pierre Shale</u>			
3 miles SE Trinidad Las Animas County	Lee, 1917	Invertebrates	U.S. Nat'l. Mus.
1 mile NE Trinidad Las Animas County	"	"	"
2 miles NE Trinidad Las Animas County	"	"	"
Sec. 25, T.32S., R.64W Las Animas County	"	"	"
2 miles N Trinidad Las Animas County	"	"	"
1 3/4 miles E Monson ?	"	"	"
2 1/4 miles E Monson ?	"	"	"
NW 1/4 Sec. 10, T.20S., R.65W. Pueblo County	Cobban, 1958	<u>Baculites</u>	U.S. Nat'l. Mus.
SE 1/4 Sec. 15, T.20S., R.64W. Pueblo County	"	"	"
NE 1/4 NW 1/4 SE 1/4 Sec. 12, T.19S., R.65W. Pueblo County	Cobban & Scott 1964	Cephalopods	U.S. Nat'l. Mus.
W 1/2 NW 1/4 Sec. 125, T.19S., R.65W Pueblo County	"	"	"
NE 1/4 NW 1/4 SE 1/4 Sec. 26, T.19S., R.65W. Pueblo County	"	<u>Tachyscaphtes</u>	"

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Pierre Shale continued</u>			
SW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 8, T.20S., R.64W. Pueblo County	Cobban & Scott 1964	Cephalopods	U.S. Nat'l. Mus.
N $\frac{1}{2}$ SE $\frac{1}{2}$ SE $\frac{1}{4}$ Sec. 11, T.19S., R.65W. Pueblo County	"	"	"
SW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 36, T.29S., R.65W. Huerfano & Las Animas Counties	Russel, 1967	Mososaur	Royal Ontario Mus.
SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 15, T.20S., R.65W. ?	Fischer, 1980	Invertebrates	U.S. Geol. Surv. or U.S. Nat'l. Mus.
NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 16, T.29S., R.65W. ?	"	"	"
NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 30, T.32S., R.63W. ?	"	"	"
SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 6, T.33S., R.63W. ?	"	"	"
SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 7, T.33S., R.63W. ?	"	"	"
SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 20, T.33S., R.63W. ?	"	"	"
<u>Trinidad Sandstone</u>			
$\frac{1}{2}$ mile E Pryor Mine near Rouse ?	Lee, 1917	Invertebrates	U.S. Nat'l. Mus.

Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Vermejo Formation</u>			
Gray Creek ?	Lee, 1917	Invertebrates	U.S. Nat'l. Mus.
SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 23, T.27S., R.67W. ?	Fischer, 1980	Vertebrates	U.S. Geol. Surv. or U.S. Nat'l. Mus.
NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 9, T.29S., R.69W. ?	"	"	"
SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 34, T.33S., R.65W. ?	"	"	"
<u>Raton Formation</u>			
SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 9, T.27S., R.67W. ?	Fischer, 1980	Vertebrates	U.S. Geol. Surv. or U.S. Nat'l. Mus.
NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 16, T.29S., R.69W. ?	"	"	"
<u>Poison Canyon Formation</u>			
SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 35, T.29S., R.69W. ?	Fischer, 1980	Vertebrates	U.S. Geol. Surv. or U.S. Nat'l. Mus.
<u>Cuchura Formation</u>			
SW $\frac{1}{4}$ Sec. 19, T.29S., R.67W. Huerfano County	Robinson, 1960	<u>Sinopa</u>	Yale Peabody Mus.
Secs. 16, 17, 20, 21, T.28S., R.68W. Huerfano County	Robinson, 1963	Vertebrates	Yale Peabody Mus. Univ. Co. Museum
NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 20, T.27S., R.69W. Huerfano County	"	<u>Lambdaotherium</u>	"

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Huerfano Formation</u>			
SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 21, T.26S., R.69W. Huerfano County	Robinson, 1966	Vertebrates	Univ. Co. Mus. Yale Peabody Mus. Am. Mus. Nat.Hist.
E $\frac{1}{2}$ SW $\frac{1}{4}$ Secs. 2 & 3, T.26S., R.70W. Huerfano County	"	"	"
SE $\frac{1}{4}$ Sec. 33, T.26S., R.69W. and NC Sec. 4, T.27S., R.69W. Huerfano County	"	"	"
SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 1, T.26S., R.70W. Huerfano County	"	"	"
NC Sec. 12, T.26S., R.70W. Huerfano County	"	"	"
*NW $\frac{1}{4}$ Sec. 33, T.26S., R.69W. Huerfano County	"	"	"
NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 21, T.28S., R.68W. Huerfano County.	"	"	"
NW $\frac{1}{4}$ Sec. 12, T.26S., R.70W. Huerfano County	"	"	"
*SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 29, T.26S., R.69W. Huerfano County	"	"	"
E $\frac{1}{2}$ Sec. 1, T.26S., R.70W. Huerfano County	"	"	"
NW $\frac{1}{4}$ Sec. 20, T.27S., R.69W. Huerfano County	Locality Files	Vertebrates	Univ. Co. Mus.

## Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 10, T.27S., R.68W. and SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 2, T.27S., R.68W. Huerfano County	Locality Files	Vertebrates	Univ. Co. Mus.
NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 2, T.27S., R.69W. Huerfano County	"	"	"
*NE $\frac{1}{4}$ Sec. 35, T.26S., R.71W. Huerfano County	Locality Files	Foraminifera	Univ. Co. Mus.
SW $\frac{1}{4}$ Sec. 4, T.27S., R.68W. Huerfano County	"	"	"
NC Sec. 12, T.26S., R.70W. Huerfano County	Simpson, 1968	<u>Peritherium</u>	Univ. Co. Mus.?
Secs. 14, 15, & 16, T.26S., R.70W. Huerfano County	Robinson, 1966	Vertebrates	Univ. Co. Mus.?
C Sec. 31, T.25S., R.69W. Huerfano County	"	"	"
SE $\frac{1}{4}$ Sec. 26, T.25S., R.70W. Huerfano County	"	"	"
*Sec. 11, T.27S., R.69W. Huerfano County	"	"	"
*Sec. 25, T.25S., R.71W. Huerfano County	"	"	"
*Sec. 30, T.25S., R.70W. Huerfano County	"	"	"

Appendix I continued.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Farisita Formation</u>			
Sec. 17 or 18, T.26S., R.60W. Huerfano County	Robinson, 1966	Vertebrates	Univ. Co. Mus.?
<u>Miscellaneous Formations</u>			
<u>Graneros to Upper Pierre</u>			
Secs. 24 & 25, T.20S., R.66W. Pueblo County	Scott, 1964	Invertebrates	U.S. Geol. Surv. or U.S. Nat'l. Mus.
Secs 32 to 36, T.20S., R.65W. Pueblo County	"	"	"
Secs. 14, 23, 25, & 35, T.19S., R.65W Pueblo County	"	"	"
Secs. 2, 10, 15, 16, & 21, T.20S., R.64W. Pueblo County	"	"	"
Secs. 9, 10, & 35, T.19S., R.64W. Pueblo County	"	"	"
<u>Dakota-Graneros Transition</u>			
NW $\frac{1}{4}$ Sec. 3, T.29S., R.60W., SE $\frac{1}{4}$ Sec. 34, T.28S., R.60W., and SW $\frac{1}{4}$ Sec. 35, T.28S., R.60W. Las Animas	Kauffman et al. 1969	Invertebrates	U.S. Nat'l. Mus. Univ. Mich. Mus.
NE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 5, T.27S., R.68E. Huerfano County	"	"	"
*SE $\frac{1}{4}$ Sec. 34 to NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 34, T.26S., R.68W. Huerfano County	"	"	"



Appendix I completed.

<u>Location</u>	<u>Reference</u>	<u>Fossils</u>	<u>Depository</u>
<u>Miscellaneous Formations continued</u>			
<u>Graneros to Greenhorn</u>			
Secs. 3 to 6 & 15 to 18, T.29S., R.59W. Las Animas County	Kauffman et al. 1969	Invertebrates	U.S. Nat'l. Mus. Univ. Mich. Mus.
<u>Dakota to Niobrara</u>			
S $\frac{1}{2}$ Sec. 4, T.27S., R.68W. Huerfano County	"	"	"
*S $\frac{1}{2}$ Sec. 5 & N $\frac{1}{2}$ Sec. 8, T.27S., R.68W. Huerfano County	"	"	"
<u>Carlile Shale to Niobrara</u>			
NW $\frac{1}{4}$ Sec. 5 & NE $\frac{1}{4}$ Sec. 6, T.27S., R.68W. Huerfano County	"	"	"
<u>Greenhorn to Niobrara</u>			
*SW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 26 to NW $\frac{1}{4}$ Sec. 35, T.26S., R.71W. Huerfano County	"	"	"

